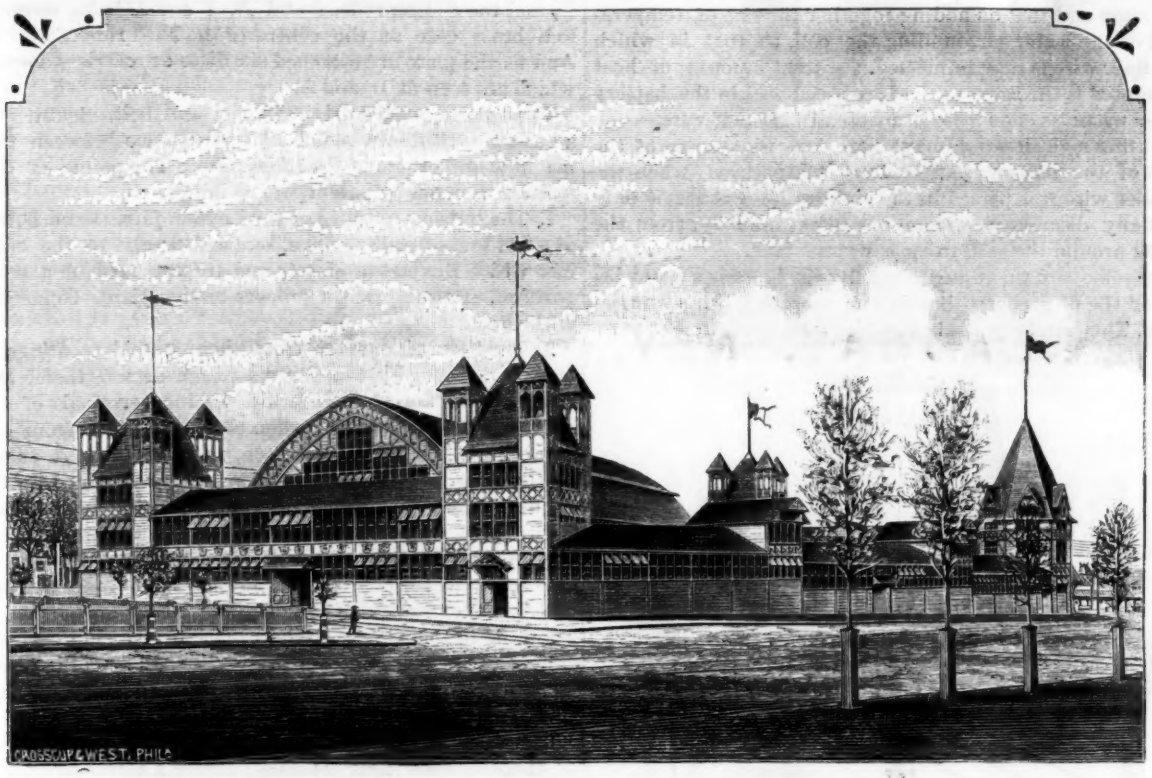
THE ELECTRICAL WORLD

VOL. III.—No 13. NEW YORK, MARCH 29, 1884. $2 PER ANNUM. 5 CENTS A COPY.

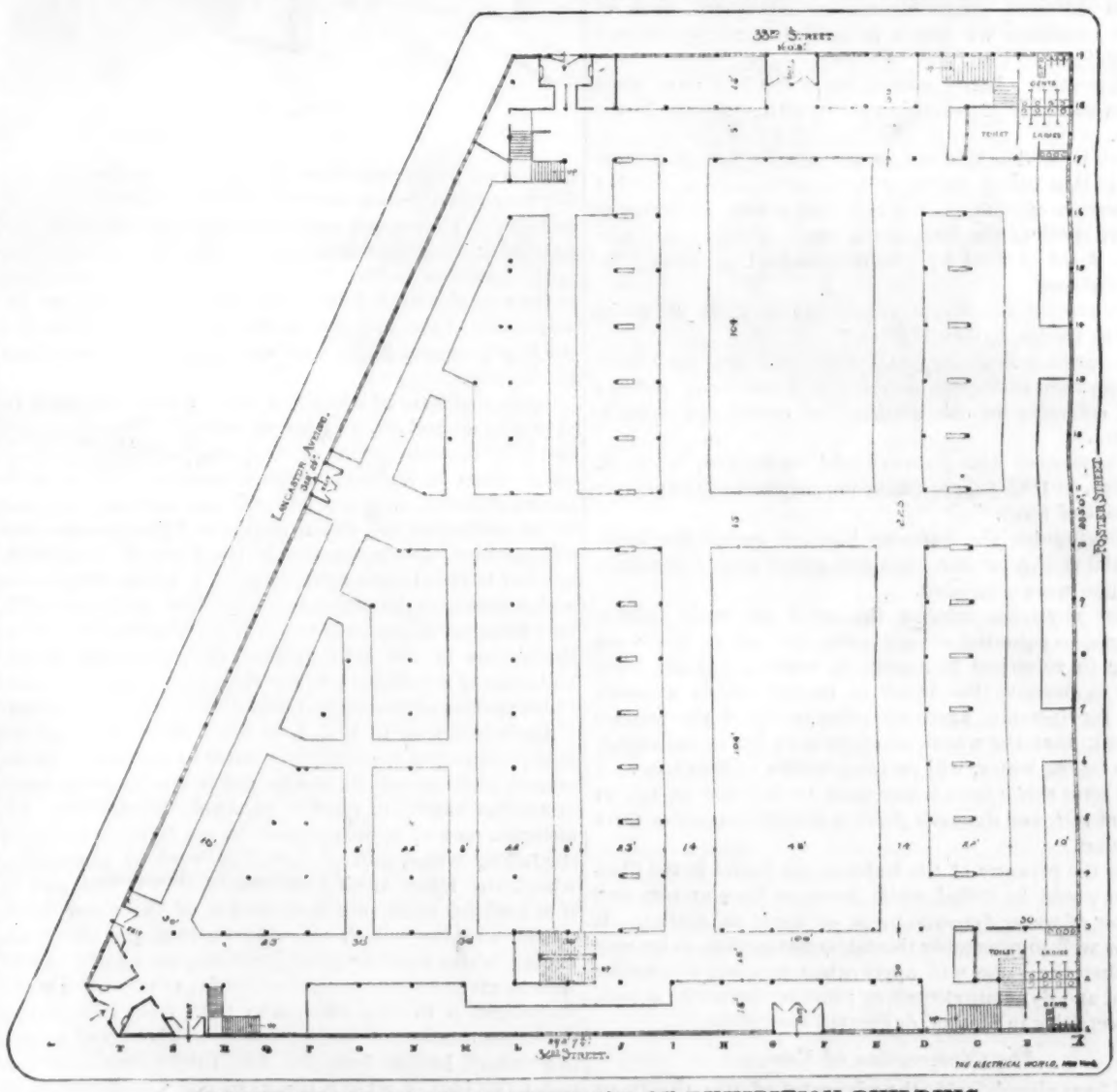
The International Electrical Exhibition.

The gradual awakening of interest in the International Electrical Exhibition, to be held at Philadelphia under the auspices of the Franklin Institute, and the declared intention of the leading electric light, telegraph, telephone, electrical instrument, and electrical supply companies, and of a host of inventors, to take active part, give early promise of a brilliant and memorable success, worthy of the science, the Institute, and the country. It will be strange, indeed, if this exhibition, extending over a period of nearly six weeks, from September 2 to October 11, is not fit to be classed with those of Paris, London, Munich and Vienna, or even to be ranked above them, for completeness, and for the impetus it gives to electrical investigations and industries.



THE INTERNATIONAL ELECTRICAL EXHIBITION BUILDING, PHILADELPHIA.

Last December we published in full the classification of the proposed exhibits, and we have since then from time to time called attention to the progress of the work. We have now much pleasure in publishing above a view of the building to be used for the exhibition and already in course of erection. With it we have also received an advance proof of an article on the subject, to appear in the April number of the *Journal* of the Institute, from the pen, we believe, of Dr. W. H. Wahl, who is taking an active and able part in the conduct of affairs. It will be seen that the building is ornate in character, and will in all probability be admirably adapted to general use, and especially to electric light displays. It is to be finished by June 15, at a cost of $30,000. The plans and specifications were made by Mr. Jos. Wilson, of the firm of Wilson Bros. & Co., architects, and the builder is Mr. Jacob R. Garber. The lot has been generously leased to the Institute for the purposes of the exhibition at a nominal rent. According to the official description, the main building will be rectangular, having a length on Foster street of 283 feet and a breadth of 160 feet, extending from Foster street to Lancaster avenue on Thirty-second street, and part of the distance from Foster street to Lancaster avenue on Thirty-third street. A tower sixty feet high will be situated at each of the four corners of this building. One central arch of 100 feet span and 200 feet in length, of the Gothic style of architecture, will cover the greater portion of the space occupied by this building, while two smaller ones, having a span of thirty feet and running parallel to it on either side, will join the towers. The building will have second story apartments at its ends on Thirty-second and Thirty-third streets respectively, with stairways leading up in the towers from the ground floor. The towers themselves will be three stories high. Two long and narrow hallways will afford communication between these apartments. The remainder of the ground will be inclosed by a large triangular building one story in height and joined to the main hall. The main entrance to the building will be at the corner of Thirty-second street and Lancaster avenue, another at Thirty-third and the avenue, and one at each of the other towers. Five exits are provided for on the plans, but desirable changes may hereafter be made in the number and situation of both entrances and exits before the work is completed.



GROUND-FLOOR PLAN OF INTERIOR OF EXHIBITION BUILDING.

In case the building should be too small, as threatens already to be the case, the untenanted depot of the Pennsylvania Railroad Company, Thirty-second and Market streets, will be available, it is thought, and connection can be established between the main building and this annex by a bridge crossing the street.

Below will also be found a plan of the ground floor of the Exhibition building. We have had this diagram made specially in order that the readers of THE ELECTRICAL WORLD may know how the building will look inside as well as out.

No doubt remains as to the number of exhibits. Probably not a single firm or company interested in electrical applications in this country will be unrepresented, and interesting and valuable contributions from abroad are confidently anticipated. An official application has been received from the Belgian government asking for such information as will enable it to make a good exhibit. Everything that can render easy the participation of foreign exhibitors has been done. At home, several of the scientific bureaus of the government will contribute. Arrangements are being made by the Signal Service for a display of all its instruments and appliances, and a branch station of the Weather Bureau will be in full operation. Besides this, the Ordnance Department of the Navy will give an exhibition of torpedoes and of the use of electricity in discharging them.

As to the attendance, all doubt, if any existed, has also been removed. The meeting of the American Association for the Advancement of Science, which will be held this year in Philadelphia, and the expected presence of many representatives of the British Association, which will meet this year in Montreal, will attract a numerous and influential scientific gathering in Philadelphia during the time of holding of the Exhibition; and in order that so exceptional an opportunity to promote the interests of science shall not be lost, the National Congress has been requested to authorize the holding of a National Conference of Electricians, to convene in Philadelphia at this time. It is hoped that Congress will pass the bill now before it making provision for the holding of the conference. The interest of the public, also, is great, and electricity now commands so much attention everywhere that the modest expectations as to attendance are likely to be far outrun.

Electrical Information for Beginners.

BY WM. MAVER, JR.—PART II.

Force.

Matter is the name given to anything which has weight and can be recognized by any one or all of the senses.

Matter, as we know, cannot move of itself; however small the substance may be, in moving it a certain amount of energy must be expended; anything therefore that moves matter must be a form of force or energy.

In nature there are many forms of force, the principal of which is gravity. The earth as a heavy body attracts all other bodies regardless of their position or shape.

Gravity is constant and unvarying in its action.

Matter is supposed to be formed of elementary parts called atoms. These atoms are held together by the force of cohesion. By the force of chemical affinity the atoms may be made to combine with other atoms, forming molecules. For instance, a molecule of water is the result of a combination of one atom of oxygen and two atoms of hydrogen.

The force of cohesion unites these molecules. This force also acts in a uniform manner; for example, one drop of water coheres to another drop of water regardless of which side of the opposite drop is presented.

There is also the force of repulsion between atoms, as when heat tends to separate them against the force of chemical affinity or of cohesion.

Repulsion also acts in a uniform manner, one atom repulsing another without regard to which side of any other atom presents itself.

In addition to these is another force called polar force, which might perhaps be termed a combination of cohesion, or attraction, and repulsion. The particles of crystalline bodies are united by this force.

For instance, one side of a particle of a crystalline body, ice for example, will attract one side and repulse the other side of a neighboring particle, while the side repulsed by the first particle will be attracted by a certain side of another particle, and in this way the body is held together.

Bodies under the influence of this force are said to be polarized.

When bodies are electrified or magnetized, they are invariably brought into a state of polarization.

Heat, light and electricity are termed physical forces.

By means of heat we can raise matter against the attraction of gravity, as when water is pumped by a steam-engine to a higher level.

By the same agent, as well as by light and electricity, chemical affinity may be overcome, or affected, etc.

Now, as a result of the operation of these different forces, we find that which we call force or energy under several different circumstances or conditions, each of which condition we would recognize if simply termed "force."

Suppose that a barrel containing water has been raised against the force of gravity to the position shown in the figure.

There is, we know, a certain pressure or *force* being exerted in that barrel, although the water is at rest.

If now we open the faucet and thus permit the water to flow we speak of the *force* of the water as it falls, and also of the *force* exerted by the water-wheel in raising the weight shown.

Here are three different conditions of force all designated by the single term "force."

The question as to the real definition of the word force has long been in dispute among physicists, some defining it as referring to one condition of energy and some to another.

On account of this disparity and ambiguity, W. J. M. Rankine, in 1853, suggested the use of the word energy in the place of force.

To distinguish the different kinds of energy the terms potential energy or attraction and actual energy or energy in motion were suggested.

Other physicists suggest the use of the word *force* in reference to potential energy only, the use of the word *energy* in reference to energy in motion, and the word *power* to describe the result of energy within a certain time, for instance, again referring to Fig. 4, the amount of work that the wheel, acted upon by the actual energy of the falling water, will perform within a given time.

The term *static force* is also used to describe energy or force at rest, and *dynamic force* to describe energy or force in motion.

Thus the pressure of the water in the barrel in the illustration would be called static force, or force at rest, and the flow of water dynamic force, or force in motion. It may be well to remember this latter distinction, as we may find that the same will apply when we come to consider statical and dynamic electricity; that is, electricity at rest, and electricity in motion, or current electricity.

The Conservation of Energy.

As I have already said, the advocates of this theory or doctrine, and they are numerous and constantly increasing, claim that energy, like matter, is indestructible. That when one form of energy disappears it is only to reappear in another form, and conversely that when one form of energy appears it is at the cost of the disappearance of another form of energy, and they illustrate these theories by many interesting and convincing experiments. For instance, taking the case of a galvanic battery, it has been shown that the chemical action within this battery always produces heat, and a stated amount of chemical action always produces a stated amount of heat.

It has been proved, however, that if heat is generated in any portion of a wire which connects the poles or different metals of the galvanic battery, a corresponding decrease of the heat generated within the battery will be noticed. For example, if we place a cell of this battery with its poles connected by a thick piece of wire in a vessel containing water, the rise of temperature in the water surrounding the cell will indicate the amount of heat produced by a certain amount of chemical action in the battery. Now, if we connect the poles of the cell by a much finer piece of the same kind of wire, and then allow the same amount of chemical action to take place, it will be found that the rise in temperature of the water is less marked than in the first case.

If now this finer wire be immersed in a separate vessel of water, it will be found that the temperature of the latter has risen and that on adding together the rise of temperature of the water surrounding the cell, to that in which the finer wire is now immersed, the total amount of heat generated is the same as that produced within the battery alone when its ends were connected by a thick wire.

At first sight it would have appeared that some of the heat of the battery had entirely disappeared when the smaller wire was placed in the circuit, but we see it only partially disappeared from one point, namely, from the water around the cell, to appear at another.

Schoolboys often amuse themselves by holding a penny between the fingers and thumb, and rubbing it briskly on the desk. They attribute the heat which soon arises in the penny

FIG. 4.

to friction. Physicists claim that the heat thus generated is due to arrested motion, and it could be conclusively demonstrated that the amount of heat generated in the metal was effected at a corresponding loss of animal heat from the boy's body—as when the motion of the electricity, in the experiment just described, was arrested by the interposition of the poor conducting wire, it was seen that the heat produced in the wire was equal to that lost within the battery.

Again one form of energy or motion may disappear to appear in several other forms of energy. Thus heat generated by the combustion of coal may disappear in generating steam in an engine which operates the now well-known dynamo-electric machine, a part of it may reappear in the motion of the steam engine and the dynamo-electric machine, another portion in the form of electricity, another in the electric light, some of it in the magnetism which regulates the carbons of that light and more of it may reappear as heat due to the arrested motion caused by the friction of the belts, pulleys, etc., of the machinery, and some of it radiates into the atmosphere, but no appreciable portion of the original heat of the coal has been lost.

Again referring to Fig. 4, it could be shown that the energy expended in raising the water in the barrel to its present position will all be returned in one form of energy or another before it reaches its former level. Thus, for instance, part of it is returned in the form of motion of the falling water, part of it in the work of turning the wheel, the latter raising the weight shown, and part of it in heat due to the arrested motion of the water in its impact with the wheel, etc. Again, that portion of the energy which was expended in raising the weight will in turn be given back in various other forms of energy when the weight is in turn allowed to fall. Such examples of the transmutation of energy could be given and proven indefinitely, but the foregoing will, I think, suffice to furnish a fair idea of what is meant by the "conservation of energy."

In the next chapter I shall endeavor to explain the theory of the correlation of all the various forms of energy, especially with its relation to electricity and magnetism, and also the theory which regards electricity as a form of motion.

(TO BE CONTINUED.)

Atkinson's Four-Plate Topler Electric Machine.

BY P. ATKINSON, A. M.

As this machine has the same construction in front as my two-plate machine, a full description of which appeared in the New York *Electrician*, and also in the London *Electrical Review*, October, 1883, it is only necessary to refer briefly to its leading features, which will be understood from Fig. 1.

It has two glass plates, *B*, stationary, and supported by hard rubber insulators, while *A*, placed at a distance of about ¼ inch in front of it, revolves in the direction of the arrow, on an axis attached to the post at *M*, through an opening in the centre of the plate *B*, to which are attached the wire brushes, *E* and *F*, and the tin-foil and paper inductors *T* and *X*.

In front of *A*, ¼ inch from the glass, are the uninsulated combs, *V* and *H*, with their brushes; and the insulated combs, *K* and *L*, connected with the Leyden jars, *C* and *D*, and the sliding rods, *P* and *R*, *V* and *H* being screwed to a brass core at the centre of the hard rubber disc *M*. And to the plate are attached six discs or carriers, two of which are seen at *W* and *Z*.

These parts, with a driving-wheel and belt, mounted on a base, constitute the points of resemblance between this machine and others of the same class. The points of difference, covered by patent, are as follows:

1. The outside coatings of the Leyden jars, *C* and *D*, are of sheet brass, forming cups, screwed firmly to the base, into which the jars fit closely and are thus held in a fixed position, affording a firm support to the plates connected with them.

2. The induced current from these outside coatings is conveyed down by the screws which attach them, and along copper wires underneath to the terminals of the switch *S*, through which, when closed, it flows from one jar to the other; but, when open, as in the cut, it passes by the brass sockets seen on the edge, out through the conducting cords, and a person, or other object connected with their outer extremities. As this induced current flows simultaneously with the direct current from the inside coatings, the switch and sliding rods place it completely under control of the operator, either for medical or scientific purposes. With the switch open a slight separation of the electrodes *P* and *R*, produces a smooth, gentle current, which may be increased to any desired strength by increasing the distance between *P* and *R*.

3. The brush-holders, *E* and *F*, are attached to the plate *B*, through holes near its edge, giving a direct passage to the electricity from the carriers on *A*, where it is generated, through the glass, to the inductors, *T* and *X*, thus interposing an insulating margin between the brush-holders and the edge, and preventing loss from leakage, unavoidable when the attachment is made by clamps on the edge.

4. The carriers on the plate, *A*, are of brass, nickel plated, with raised centres, making them durable, ornamental and permanent, without any possibility of becoming detached from the glass, or defaced, like carriers with centres put on over tin-foil bases.

5. The combs, *V* and *K*, also *H* and *L*, radiate at an angle of 45 degrees to each other from the central disc, *M*, to which they are permanently attached, thus avoiding all possibility of error in position or of displacement.

There are numerous other improvements of minor importance, to which it is unnecessary to refer specifically.

THE FOUR-PLATE MACHINE has the same construction in front, but a special construction for the two rear plates, which will be understood by reference to the cuts.

The end view, Fig. 2, shows two pairs of plates, the position of the rear pair being reversed, which brings the stationary plates into the centre, back to back, between the revolving plates, so that the inductors are on the inner faces of the stationary plates, and the carriers on the outer faces of the revolving plates, which, being mounted on the same shaft, with a collar between them, revolve in unison.

The combs, *L* and *K* and *V* and *H*, have curved rods attached to their ends, which pass round the plates and support duplicate combs in the rear, as shown in Figs. 2 and 3. The brushes are also duplicated, as shown in the cuts; so that with the exception of the Leyden jars and switch, and parts directly connected with them, this is practically, a double machine.

ITS MODE OF ACTION is the same as that of the two-plate machine, and the leading points may be briefly noticed as follows:

The friction of the brushes, *F* and *E*, with the raised centres of the carriers, as the plate, *A*, revolves, generates an initial electric charge. Following any two carriers, as *W* and *Z*, we notice that this charge passes, by the brush-holders, through the stationary plate, *B*, and along the tin-foil strips, shown by the dark shade, to the inductors, *T* and *X*, on its rear face. So that, at the instant of the contact, the potential of all these parts is raised to the same degree; but at the next instant the contact is broken, and carriers and inductors being insulated from each other, the initial charge, produced by friction, is increased by their mutual induction.

When *W* and *Z* arrive at the insulated combs *L* and *K*, a transfer of electricity takes place between the carriers and Leyden jars, through *L* and *K*. But the potential of carrier *W*, and inductor *T*, is higher than that of carrier

Z and inductor X, from the better insulation of the brush-holder E on the upper half of the plate B; free from the inductive influence of the Leyden jar and other parts in close proximity with the brush-holder F. This difference of potential is further increased by the induction of the earth, which condenses the electric charge on the lower ends of the inductors T and X, a portion of which escapes from X through the brush-holder F, while the lower end of inductor T has no similar outlet. Hence the potential of the inner coating of the jar D becomes higher than that of the jar C, making it positive, and repelling electricity from its outer coating, making it negative. Hence, when W and Z are opposite L and K the flow of electric energy is from the carrier W and adjacent parts of the plate A, through the comb L to the inner coating of jar D, and from the inner coating of C through the comb K to the carrier Z and adjacent parts of A. Hence the inner coating of D becomes positive and that of C negative, the potential of the outer coatings being the reverse.

When the difference of potential between the inner coatings becomes sufficient to overcome the resistance of the air a discharge takes place from R to P, and, at the same instant, a discharge from the outer coatings takes place in reverse order through the switch and connections from C to D.

The discharge from R to P may be increased to several inches, varying according to the capacity of the machine. The lower discharge may be observed by opening the switch, when the sparks will be simultaneous above and below; but when it is closed the lower discharge takes place silently; and the same is true when the switch is open and the connections are made through the conducting cords and a person holding the handles, as in Fig. 1; when a current similar to the Faradic is felt, the strength of which depends on the distance to which P and R are separated; $\frac{1}{32}$ inch giving a mild current, and $\frac{1}{4}$ inch as strong as can be borne without undue severity.

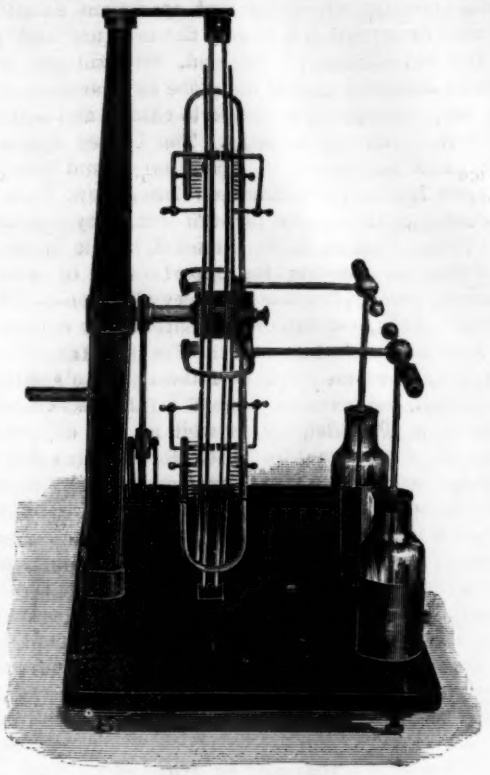


FIG. 2—END VIEW.

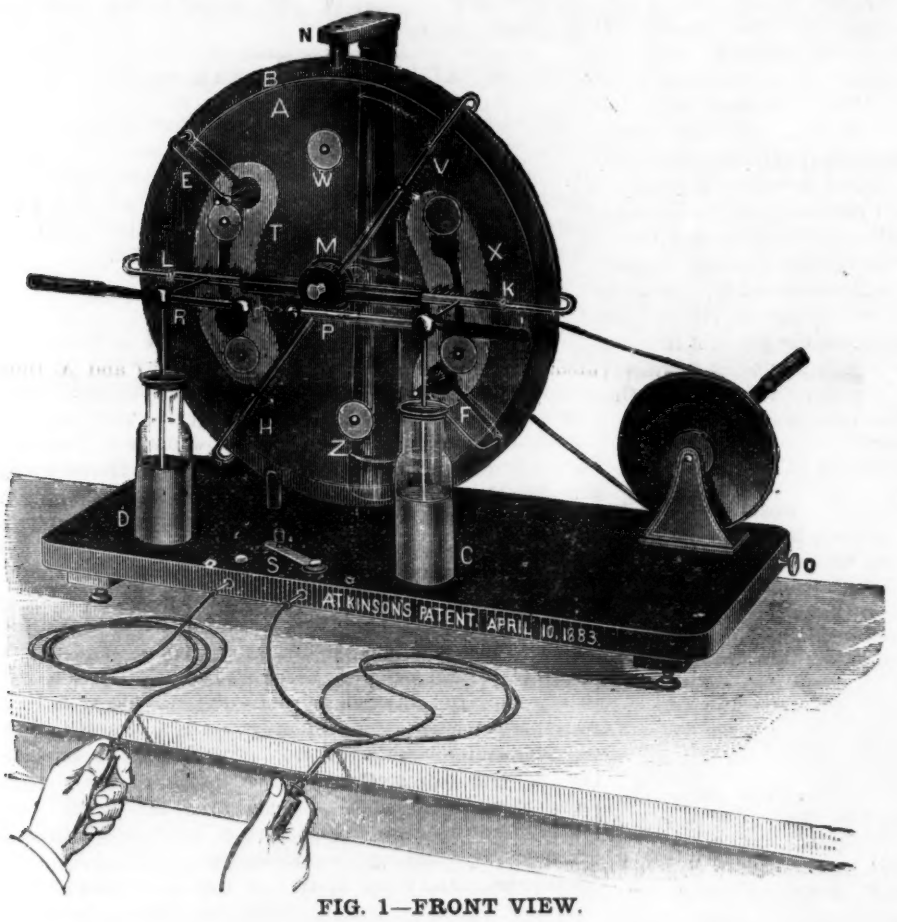


FIG. 1—FRONT VIEW.

Following the carriers W and Z, after they leave the insulated combs L and K, we find that as they approach the uninsulated combs H and V, W has a negative potential from having given up electricity to L, while Z is positive from having received electricity from K; and the intensity of these conditions is increased by induction from the opposite electric conditions of the inductors T and X. As W passes under the comb H and is brought into contact with its brush, Z passes under V and is touched by its brush; and a silent discharge takes place from Z to W through the combs V and H, which are in electric connection through the brass core of M, and the equilibrium is restored, so that they approach the brushes F and E in a neutral condition, as at first.

It should be noticed that the electric charge is instantly diffused over the metal carriers and inductors, more slowly over the paper inductors, and still more slowly over the shellacked surfaces of the glass plates. So that when the machine is put in action, after a considerable interval of rest, three or four seconds elapse before it becomes fully charged, and a crackling sound is heard from the electricity forcing itself over the resisting surfaces of the paper and glass. The surfaces of the plates, on which the carriers and inductors are mounted, assume the same potential as the carriers and inductors attached to them, while their opposite surfaces have the reverse. Opposite parts of the same surface are also in opposite electric states: the section L, M, H, for instance, having a potential opposite to that of V, M, K, the action of the combs changing the potential of the surfaces simultaneously with that of the carriers and inductors, as already described.

It will be noticed that the office of the brushes E and F is the reverse of that of H and V. E and F *generate by friction*, while H and V *discharge by contact*. And, while the combs K and L aid in creating a difference of potential, the combs H and V aid in restoring equilibrium.

In the description of my two-plate machine, already referred to, it is stated that "better results have been obtained by increasing the size rather than the number of the plates." This was written immediately after the construction of a four-plate machine with movable and stationary plates, alternating in position and only the same number of combs and brushes as in the two-plate machine, relying on the induction of the two additional plates for increase of energy.

The experiment was a failure, the energy being little, if any, greater than from two plates. But the energy of my present four-plate machine is more than double that of a two-plate of the same size. It gives easily, without any resort to the drawing out process, 65 sparks, 6½ inches long, per minute, while a two-plate machine of the same size—plates 25 and 28 inches diameter—gives but 30. The five extra sparks, above double the number, may be accounted for by the better insulation of the duplicate combs and brushes. These are thick sparks, with the snap of a revolver to them, showing great intensity.

This is a very rough, inaccurate method of measurement, and the results are, of course, only approximate; but they are the best that can be obtained, in the absence of expensive instruments, and give a good general idea of the comparative energy of the two machines.

A galvanometer is useless for the measurement of static electricity, as the best wrapped wire will not insulate it; and it is doubtful whether a quadrant electrometer, as ordinarily constructed, would have sufficient insulation to measure electricity of such tension as to give sparks nine or more inches in length and to perforate easily a glass jar ⅛ inch thick.

A voltameter is generally useless, as little, if any, perceptible electrolysis can be obtained even from static machines of great energy. This is generally attributed to their small quantity compared with their great tension, and with the electrolysis obtainable from galvanic electricity, in which these conditions are reversed. An accurate and more practical means of measurement could probably be found in the amount of force required to rotate the plates, which increases in the proportion of their size and number.

But the spark is commonly relied on for measurement, and a very erroneous impression prevails that *length* of spark is a correct criterion. But *frequency* and *intensity* are as important as length. Long, thin sparks of small intensity may be obtained at considerable intervals from machines of very limited capacity.

Length, frequency and intensity are the three factors to be considered. The first two can be accurately measured, but the intensity must be inferred from the apparent thickness of the spark, the loudness of the report and the ability to penetrate glass, paper, or other dielectrics. And in the light of these facts the superior energy of my four-plate machine becomes at once apparent.

The smoothness of the induced current, and the constancy of the charge, are points of great importance in this machine, especially in medical practice, where static machines are now extensively used.

This current from the outside coatings of the Leyden jars, as already explained, is superior in smoothness to that obtainable from the best Faradic battery, and may be varied by separation of the sliding electrodes, from a current mild enough for an infant to one powerful enough for a giant.

It will be understood that this current consists of a rapid succession of impulses, produced by the charge and discharge; and, in small machines, the requisite energy is obtained by increased separation of the sliding electrodes, producing increased intervals between the impulses, during which the energy accumulates, which makes the currents jerky and disagreeable, while in this machine the same energy is obtained at much shorter intervals, giving the impression of continuity; so that, with a mild current, the separate impulses are imperceptible. It is the difference between a musical note and the whir of a buzz saw.

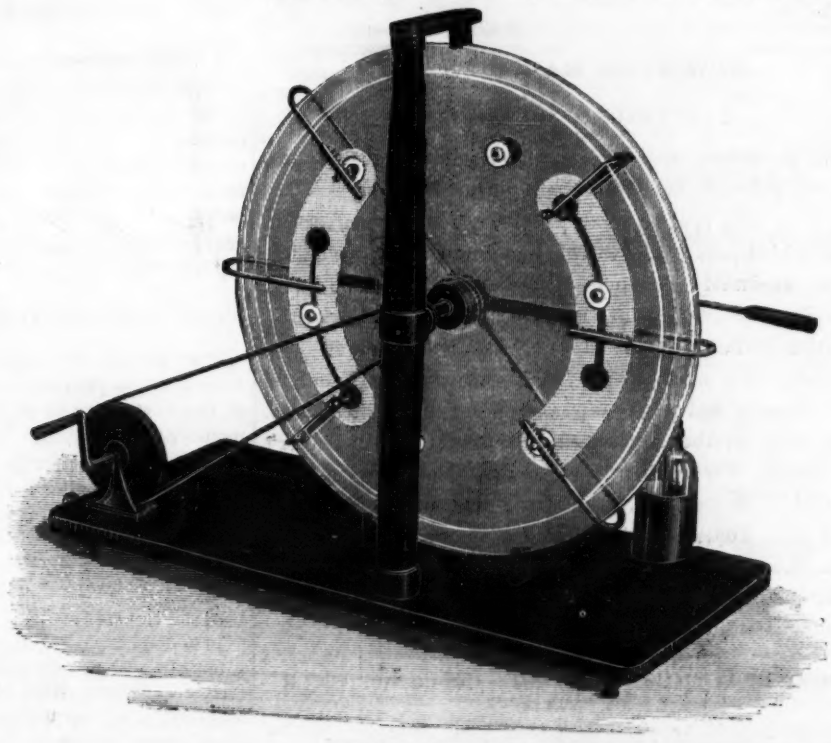


FIG. 3—REAR VIEW.

The constancy of the charge is shown by the fact that a residual spark may be obtained even after the machine has remained unused 37 hours in a cold room, and on putting the plate in motion a full charge results almost instantly.

This will be appreciated by any one who has attempted to operate a Holtz machine under unfavorable circumstances. My attention was recently called to a self-inciting Holtz in use in a large medical establishment, where the physician informed me that it often required three hours' manipulation to charge his machine, while mine charges itself in the same number of seconds.

COUNCIL BLUFFS, IA.—After a thorough trial 25 Thomson-Houston arc lights at Council Bluffs, Iowa, have proved so satisfactory that apparatus has been purchased there for 75 lights.

CUTTING RATES.—A Philadelphia dispatch says: The Postal Telegraph Company has declared war, and posted rates from Philadelphia to Washington, Baltimore and New York 15c. for 20 words.

CITY LIGHTING, PROVIDENCE, R. I.—The Thomson-Houston electric lighting system has won a triumph at Providence, in the face of determined opposition. The local company recently established there by the American Electric and Illuminating Company, of Boston, to furnish the Thomson-Houston light to Providence, has received the entire contract for the city electric lights, the number of which is also raised from 60 to 75.

THE
ELECTRICAL WORLD,
PUBLISHED WEEKLY AT
No. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, - Editor and Publisher.

ASSOCIATE EDITORS.

C. O. MAILLOUX, - - - Scientific Department.
T. C. MARTIN, - - - - - News Department.
CLARENCE E. STUMP, Business Manager.

Mr. Mailloux, the expert of THE ELECTRICAL WORLD, writes for it exclusively. His articles are designated thus: *.*.

Articles in the preparation of which he has assisted, and the views and statements in which he therefore indorses, are marked, **.

Correspondence on all electrical subjects is solicited. Readers are cordially invited to communicate their views and opinions on all topics within the province of this journal. Items of information relating to any application of electrical science will be thankfully received. Our friends will render us a valuable service by forwarding news *promptly* as it occurs, and by mailing us marked copies of their local papers containing anything likely to interest our readers. Anonymous communications not noticed. Rejected manuscript cannot be returned unless accompanied by the necessary postage when received.

Correspondence other than of a business nature, should not be addressed to individuals, but solely to

"The Editor of The Electrical World, New York."

All communications relating to subscriptions, book orders, advertising, or of a business nature, should be addressed

W. J. JOHNSTON, Publisher, 9 Murray St. New York.

THE ELECTRICAL WORLD HAS
THE LARGEST CIRCULATION
Of any Electrical Journal in the World.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $2.00.

Postage to any part of the United States or Canada is always prepaid by the Publisher. Addresses changed as often as desired free. Always give the **old** as well as the new address.

ADVERTISING RATES,

Circulation considered, are lower than those of any similar first-clas journal. The price varies according to position and number of insertions.

Notice of Situations or Help Wanted, $1 to $3 per insertion.

NEW YORK, MARCH 29, 1884

ELECTRICAL JOURNALISM.

We lay before our readers to-day a paper profusely illustrated, and with most varied and interesting contents. In order to find space for all the extra reading matter we have added four pages to this issue, making it, we think, a very creditable specimen of electrical journalistic work. We give a description of the International Electrical Exhibition Building, Philadelphia, with two original cuts, and also show what our progressive Boston friends can do in designing and fitting up a splendid arc-light station. We print another illustrated installment of Mr. Maver's excellent "Electrical Information for Beginners," and we publish a description, with three cuts, of the Atkinson four-plate Töpler Electric Machine, from the pen of Mr. Atkinson himself. The description of the Pilsen lamp is concluded. Besides these valuable illustrated articles the reading will all be found good and useful.

THE PRACTICAL SIDE OF INTERNATIONAL EXHIBITIONS.

It is a noteworthy fact that, on this side of the Atlantic, we have depended almost exclusively upon American inventive skill for the creation and improvement of the apparatus and devices required in the utilization of electricity for industrial purposes. In this branch of invention, as in many others, we have been "exporters" rather than importers, and to such an extent that—in electric lighting for instance—the names of Brush, Edison, Maxim and many others, are quite as well known abroad as in this country. But this fact, we should add, must not be construed so as to totally disparage the merits and the value of European inventions, for the four electrical expositions which have been held in Europe so far have all shown that inventors there are as active and as successful as here in the search after practical results. The extensive adoption of many American systems of electric lighting abroad is due in great measure to the excellent opportunities which these expositions have placed in the way of our inventors for displaying the distinctive merits of their inventions. One of the reasons why European electric lighting systems have remained comparatively unknown in this country, so far as practical use is concerned, is that these expositions have afforded them a ready and more handy market. Another reason is the lack of such opportunities for public demonstration of their merits here. A system of electric lighting is eminently one of the things that "must be seen to be appreciated," and it is precisely because these systems have not been seen in this country that they are not recognized and adopted. Many of these systems possess distinctive features of much merit, and their adoption would lead to further advancement and progress in the art.

What can be said of electric lighting also applies to telephony and other branches of invention in the electrical field. Peculiar conditions of social life or commercial development will cause inventors in one country to go much further in a certain direction than the inventors do in another country where different conditions exist; for the inventor or invention is largely the creature and product of the environment. England, for example, with her colonies scattered around the globe and her ships in every sea, has given special attention to cables, and is the home of the cable-making industry. The United States, on the other hand, has carried the operation of land lines stretching from Mexico to Canada, and from New York to San Francisco, to the highest point of efficiency yet attained. This comparison might be extended, but it is enough to show that the necessity for opportunities of seeing how discovery and application are everywhere pushed forward increases daily, and can only be satisfied by exhibitions of the kind now undertaken by the Franklin Institute.

Having considered the desirability of an International Exhibition, and given on page 97 a full description of the building at Philadelphia, as well as the objects of the directors of the Franklin Institute, we think that a few practical words as to the course adopted for meeting the expenses will not be out of place. For defraying the cost of such a building and of the exhibition a considerable outlay of money will be required. It is confidently expected that such expenditures will be met by the receipts from the exhibition, and no exertion will be spared to accomplish that end; but as the Institute is not in a condition to make advances of money for these purposes it is proposed to borrow it on guarantees, subscribed by members of the Institute and such others as take an interest in the matter. The sums so guaranteed will only be called for to the extent that may be required to meet the expenses, if the receipts should fail to do so. It is estimated that at least fifty thousand dollars will be required for the preliminary outlay, but it is proposed to obtain subscribed guarantees for a larger amount, so that possible calls on each guarantor may be diminished to the smallest percentage of the sum subscribed. We understand that the guarantee fund is already about $40,000. The last exhibition of the Franklin Institute—one of a general character—was held ten years ago, and netted a profit of $52,000. Dr. Wahl, who enjoys excellent opportunities for forming an opinion on the subject, thinks that the Electrical Exhibition will prove a not less profitable undertaking. Applications for space up to March 25 numbered 68. A most encouraging feature is that in Philadelphia, so closely connected with the memory of Franklin, the greatest interest is felt in the Exhibition and the most sanguine expectations are entertained there of its success. It is felt that the work is under able and judicious management.

THE PHONOGRAPH IN LINGUISTIC SCIENCE.

Few men have more startled the world than did Mr. Edison a few years ago when he made his great discovery of the possibility of reproducing speech mechanically by means of the phonograph. But the sensation died away quickly, and, although the merit of the machine was everywhere admitted, no practical application could be found for it. We question whether any phonographs have been manufactured here during the last two years, and certainly up to the present time nothing whatever has come of the lavish promises made of phonograph speech reports, letters, records and the like.

It is difficult to believe, however, that the phonograph must always remain a scientific toy, to be used merely in laboratory or lecture-hall experiments. We now learn from Germany that Doctors Zintgraff and Chavanne, who are about to visit the Congo and the interior of the Dark Continent, take with them a phonograph for the purpose of fixing the speech and the melodies of unknown tribes. The record will be forwarded to scientific men in Germany, and there heard again. It is stated that the apparatus has been made by Mr. Fuhrman, of Berlin. As the engraved or indented tinfoil has been successfully sent long distances before, there seems no reason why this could not be done. The chief difficulty will lie, perhaps, in getting the gentle African to narrate to the machine the adventures of Mary and her lamb, or to describe the idiosyncrasies of the little girl with a curl. What the precise value of the record will be we cannot undertake to say. If the language be soft and liquid, or full of "clicks," the phonograph may not do it justice. If it be harsh and guttural, with rolling sounds, it may come out well, but even then intonation and pitch will not be preserved in due proportion. As the record is to be refitted for use, the flat plate with clockwork will probably be used in preference to the familiar cylinder with winch and flywheel. The German linguists will do well to bear in mind the observation made by the late Count du Moncel, from an experiment of his own, that speech registered in a very hot room is imperfectly reproduced in a cold room. The climate of Northern Germany does not always correspond to that of Equatorial Africa.

TELEPHONIC PROFIT AND PROGRESS.

We publish on another page a very full report of the annual meeting of the American Bell Telephone Company. It will be seen that a very profitable business is done, and that the use of the telephone grows steadily, the number of instruments under rental being now over 300,000. Outside the points gone over in our summary the most important are the statements that the line between Boston and New York is now about ready for trial, and that "We have renewed our arrangements with Mr. Bell for his experimental work, and that of his associate in the Volta Laboratory, and all telephonic inventions made by these men belong to the company." It will be observed that a defense is made of consolidation on the score of economy, and that reference is made to the costly, but by no means satisfactory experiments in underground telephony. The directors express confidence as to the results of the Drawbaugh suits, and deprecate the loose newspaper talk, of which there has been a deluge, about the affairs of the company. One criticism made on the financial exhibit is that "patents" appeared as assets in 1882, and are now set down as liabilities. The meaning of this is not clear. It is charged by those who do not call themselves friends of the company that prominent men in it have been "unloading" their stock to a large extent. Perhaps they want to buy in again on a lower market.

THE MECHANICAL THEORY OF MAGNETISM.

We have received, with the compliments of the author, an advance printed copy of the able paper read by Prof. D. E. Hughes, F. R. S., before the Royal Institution of Great Britain on "The Theory of Magnetism."

Our readers will remember that last June—thanks to a similar kindness on the part of Prof. Hughes—we were then enabled to put before them his valuable paper on "The Cause of Evident Magnetism in Iron, Steel and Other Magnetic Metals." That paper was read with much interest here, and we are confident that all electricians and students of electricity will welcome this later and supplementary statement of the result of his investigations and experiments, in seeking to establish the mechanical theory of magnetism. We begin in this issue the publication of the paper.

A NATIONAL ELECTRICAL SOCIETY.

We learn that a movement has been inaugurated for the formation of a national electrical society, and that several distinguished men connected with the science and with electrical enterprises have promised it their warmest support. The idea is admirable, and cannot but succeed. It is said that details will shortly be made public.

Electric Lighting Wires in New York.

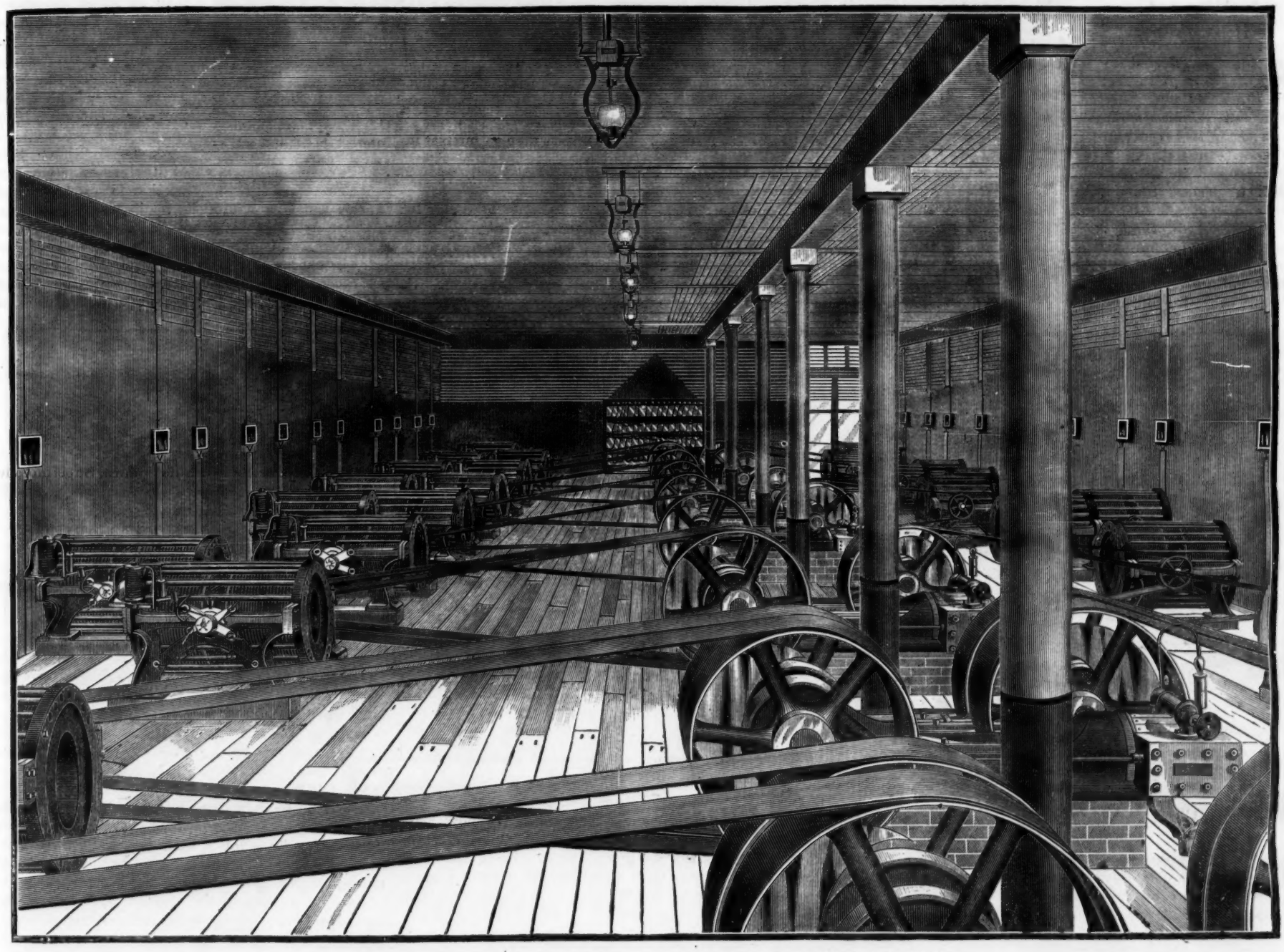
Mayor Edson forwarded to the Board of Aldermen, on the 18th, a report from G. Elliot Smith, Superintendent of the Fire Alarm Telegraph system, and asked that immediate action be taken on the matter referred to. The Superintendent calls attention to the damage to a number of the fire signal boxes in consequence of interference with the department's circuits by wires of the electric lighting companies. He holds that the wires of the companies have been erected hastily and without attention to the interest of the Fire Department. Especially is this said to be true in Broadway. Instances are given where the electric light wires have destroyed four telephone instruments, one alarm gong and 18 street boxes. The central office relays and switches have been frequently damaged. The pecuniary loss was slight, but the possibility of a fire originating when the system was out of order made it imperative that there should be reasonable means for protection. The danger, the report sets forth, is not confined to a direct contact with a fire-alarm wire, but may be conveyed thereto through any other wire happening to be crossed at a distant point. The whole system is thus endangered by the network of wires, and it might be annihilated at any moment. One remedy suggested is the placing of the wires of the electric light companies under ground, but the danger, it is suggested, might be diminished through a milder remedy. Proper ordinances, with certain regulations governing the placement of all the outside wires and appliances of the light systems, should be enacted. It is also suggested that authority should be had to compel the electric light companies to discontinue the currents in hazardous periods, such as during the prevalence of high winds, storms, etc. The draft of an ordinance was submitted with the report. It provides that all electric light wires to be strung in the future shall be placed under ground. It also imposes several regulations looking to the safety of the fire-alarm wires where electric wires are already in existence. The matter was referred to the Committee on Fire and Buildings.

THE TELEGRAPH WAR IN TEXAS.—The telegraphic rate war between the Western Union and the Gulf, Colorado & Santa Fe Railroad is becoming very interesting. The Western Union has made one cut and the Santa Fe two. The Western Union cut was on an average of 33⅓ per cent. to points beyond Texas and an average of 15 to 20 per cent. within the State. The Santa Fe has cut under the Western Union reduced rates, making as high as 50 per cent. reduction to many places. Points served with ten words by the Western Union for 25 cents are served by the Santa Fe for 15 cents. This war within Texas, it is predicted, will soon extend beyond the State, as the Santa Fe are indirectly working to reach New Orleans from Houston and Galveston, and to put their wires north from Dallas and Fort Worth to Kansas City and St. Louis, to connections with the Baltimore & Ohio. It is said that arrangements will be made by which daily papers in Texas, now deprived of the Associated Press reports, will be served by a rival news association.

The Finest Arc-Light Station in the Country.

The opening of the new station of the Merchants' Electric Light and Power Company, Boston, has been awaited with much interest. As the work is now on the point of completion we are enabled through the courtesy of the company to give a full description, with illustrations, of this station, said to be the finest arc-lighting station in the United States, if not in the world. No one who has seen the station and plant, and realized the magnitude of the undertaking and investment, could have any doubt as to the fact that the electric light has come to stay. The impression derived from an inspection of the work is one of permanence, solidity, efficiency and foresight, in an installation where utility and convenience have not been sacrificed to show, but where great attention has nevertheless been paid to comeliness of appearance and to those little details lacking which the most extensive installation looks crude, cheap, and unfinished. It may be stated that the subjoined description is official and authoritative.

The new central lighting station of the Merchants' Electric Light and Power Company is located at the junction of Congress and Mathews streets, in the large and commodious brick and granite building owned by Messrs. Henry Poor & Sons. The building is four stories high, and was originally built for the purpose of a wholesale leather store. To meet the requirements of this business particular attention was given by the builders to the architectural design, which is plain but massive. Entering the building at 199 Congress street the visitor steps into a large and convenient office, well lighted, and separated from the main dynamo room by a glass partition, and is occupied by the officers of the company, its situation giving them at all times a perfect oversight of the workings of the establishment. The office is tastefully painted and decorated, and furnished in handsome and appropriate style, presenting an attractive and rich appearance. Stepping through a large double door the visitor finds himself in the main dynamo room. This room is declared by competent experts to be the largest and most finely equipped of any in the world. The total length is one hundred and ten feet, and the width is forty-six feet. As the first step on the road to success in such an enterprise is strength and rigidity the floor was reinforced by the addition of a "crib" of heavy iron girders and hard pine timber. The construction of this crib is substantially as follows: Stringers of hard pine plank, three inches thick by twelve inches broad, were laid lengthwise from end to end of the room, at a distance of one foot apart. These were carefully "spotted" to the floor, until a perfectly even and level surface was obtained. Across these, from side to side of the room, were placed 3 × 12-inch channel iron girders, laid flat and filled with 5½ × 10-inch hard pine timbers. These compound girders were laid three feet on centres. Midway between the channel irons were laid 6 × 6-inch hard pine bolsters. Each intersection of girder and stringer is secured by two ⅞-inch bolts, extending through the floor into the basement, and screwed up to a bearing on 4 × 6 longitudinal hard pine yokes. This arrangement not only binds the crib firmly together, but also binds the crib to the floor. On the last course of girders is laid a 1¾-inch hard pine floor. The peculiar arrangement of the floor and crib results in extraordinary rigidity. In the construction of this crib were used nearly 100,000 pounds of iron girders, 25,000 feet of hard pine and 1,000 bolts of all kinds, besides lag and drive screws. To support the enormous weight of crib, engines and dynamos, huge bolsters of 12 × 16-inch hard pine were placed beneath the floor, and supported by 16 × 16 and 12 × 19-inch brick piers, placed in three lines through the basement, those in the centre being only four feet apart.



THE MAIN DYNAMO ROOM AT THE NEW STATION, BOSTON.

The motive power for driving the dynamos is furnished by the celebrated Armington & Sims high speed engines, of which there are to be sixteen in the main dynamo room. These engines are located in the centre of the room, a long line extending from end to end, and alternately facing in opposite directions. The engines rest on brick foundations, and are bolted down in a manner similar to that used in the case of the crib. The generators, improved Thomson-Houston dynamos, are arranged in four lines, along the sides of the room; two lines extending along either side, the arrangement of the machinery being that calculated to produce the least possible amount of vibration.

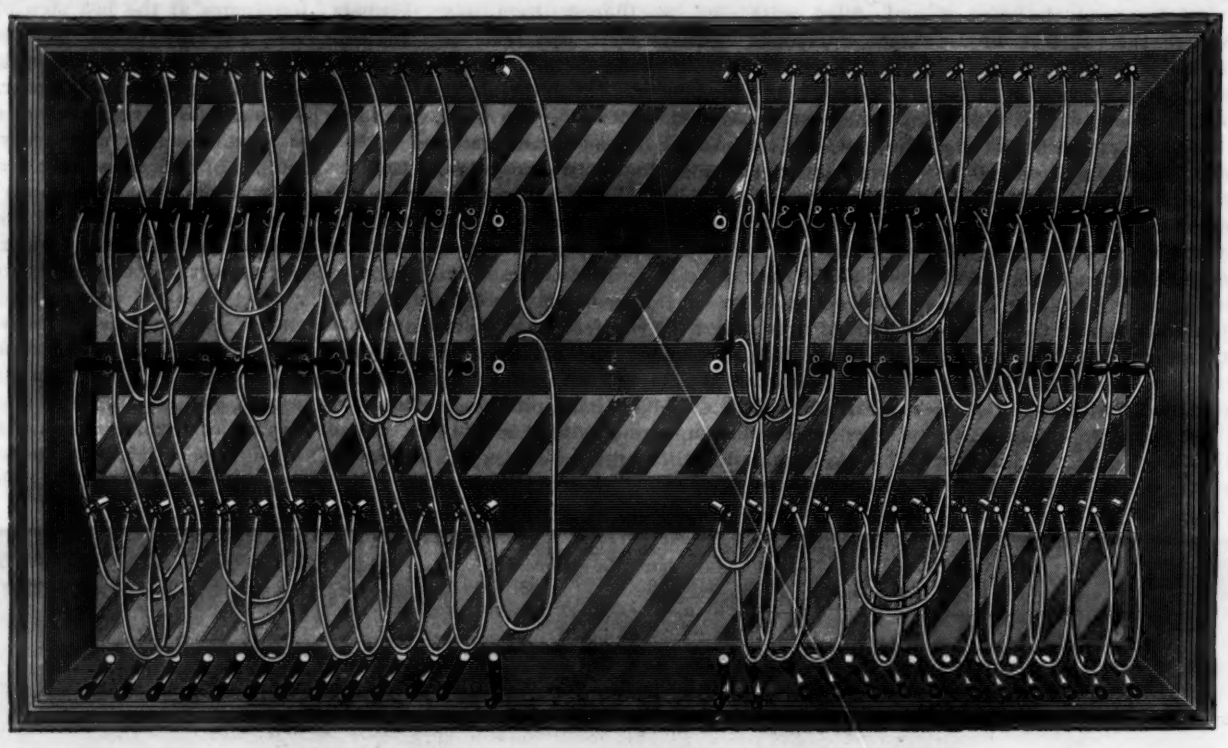
The wiring is done on a novel plan, the negative wires from the dynamos being run under the floor, as are also the short-circuiting field wires, while the positive wires are run along either wall; and on the ceiling lie the wires supplying current to the pilot lamps, one of which is included in each working circuit. The pilot lamps serve to show to those in charge of the dynamos the exact working of the lights. The wires are not sheathed, but are carefully cleated to the walls, thus giving at all times immediate opportunity for discovering trouble.

The chimney, located in the rear of the building, is 180 feet high, and required 125,000 bricks in its construction. Its external diameter at the base is 12 feet, at the top 9 feet 6 inches. The core is 12 inches in thickness, and has an interneal diameter at the base of 7 feet; at the top of 7 feet 6 inches. Between the shell and core is an air space of 6 inches. The core extends upward 6 feet, and terminates at the last step of the shell. The estimated weight of the structure is about 475 tons. Two main subterranean flues, 2 feet 10 inches wide by 7 feet high, connect the chimney and boiler. These flues have 12-inch walls and are paved and cemented water-tight. By means of capacious iron doors easy entrance is effected to the interior of both flues and chimney.

Six of the eight boilers are already in position. They were especially built for this station by the Cunningham Iron Works of Boston, and, embodying as they do, many novel ideas in construction and setting, they are in every respect models of workmanship and excellence. The setting is that so popularly known as the "Jarvis," and the arrangement is in two batteries of four boilers each. The engines are supplied with steam by means of two steam drums, each ten inches in diameter, and so connected that any boiler or combination of boilers may run any section of engines. This arrangement provides for any possible break-down on the part of either engines or boilers. The exhaust is conducted by means of two 12-inch drums through a battery of National Feed-water Heaters, thence into a large iron tank provided with two relief pipes, extending through the roof. Feed water is supplied to the boilers by means of two No. 5 Dean steam pumps, one pump to each battery of boilers. These pumps were especially made for the work, and are highly finished in nickel plate. They are so connected that should one break down the other may do its work. Each nest of boilers, of which there are two in a battery, is provided with one of the celebrated Korting injectors, No. 8. These are directly connected with the water main, thus reducing the chances of lack of water to a minimum. The water supply is furnished by two 1½ inch pipes, one entering from Congress street, the other from Leather Square. The firing pits are twenty feet square, and are five feet below the general level of the main boiler room. Ventilation is furnished by powerful fan blowers, which throw large volumes of cool air into these pits. Coal is taken in from Congress street, and from the huge storage bins is transferred to the furnaces by small cars. The coal is run over a Fairbanks platform scale, on its way to the pits, every load being weighed. The piping of the boilers is all of brass, and of the simplest design. All the various fixtures, as injectors, pumps and gauges are secured to their respective pipes by "unions," thus rendering them easily

accessible for examination and repair. All the piping and fixtures are in plain sight and at all times easy of inspection. The celebrated Chapman valves are used in all cases on the water pipes, and globe valves of Cunningham and Jenkins' make are used in other cases. The blow-offs are conducted into a large tank, $12 \times 6 \times 5$ feet which communicates with the sewer by means of an overflow.

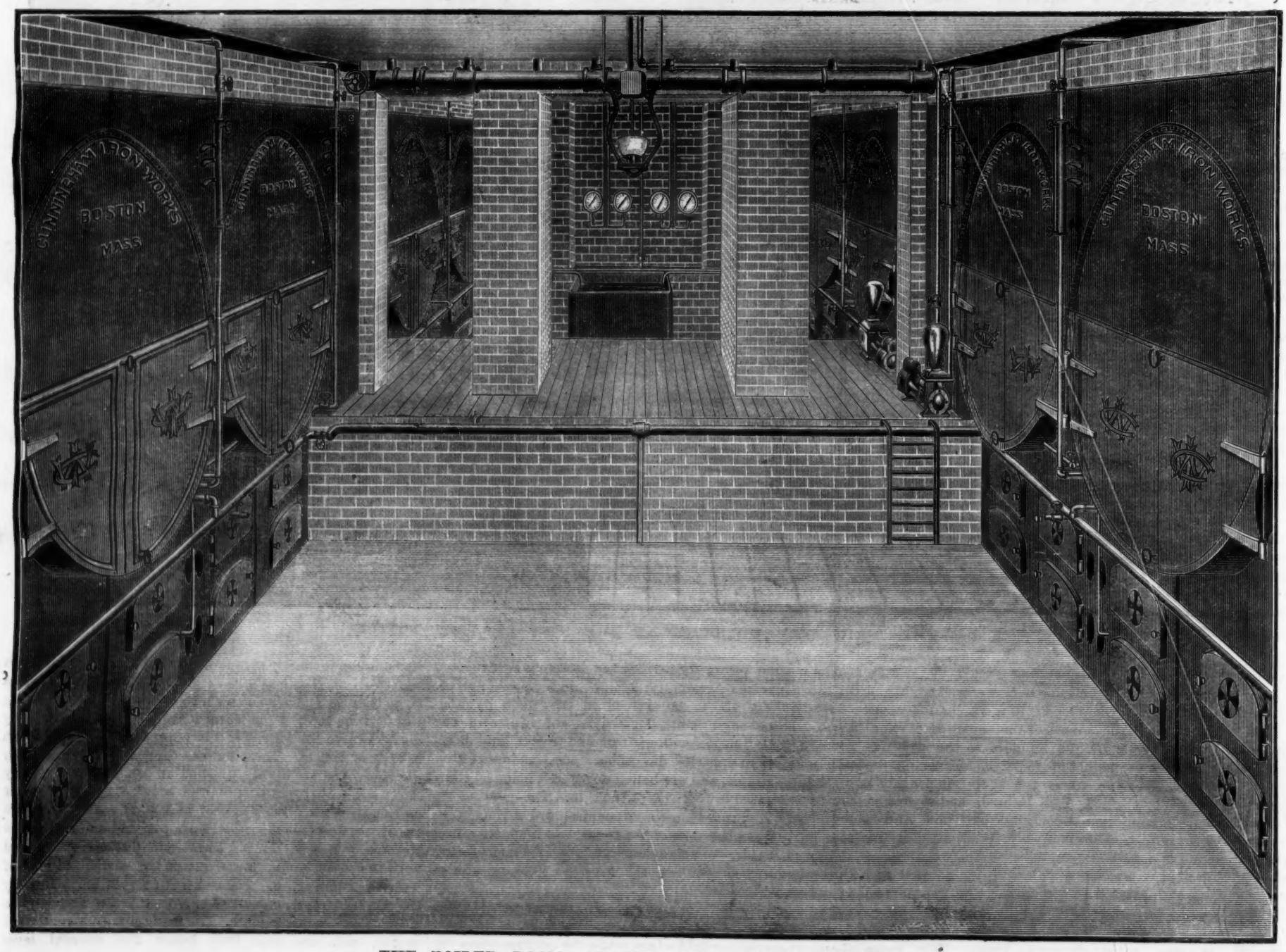
The switchboard, located at the rear end of the room, is the joint invention of Mr. E. J. Welsh, the electrician of the American Electric and Illuminati g Company, and Mr. L. W. Janes. The board is eight feet, eleven inches long, and five feet, three inches wide The material is black walnut with ash trimmings. For simplicity, durability, and effectiveness it is a model piece of mechanism. The switching is effected by plugs of telescope tubing, the inner, or plug tube being slit longitudinally for a part of its length and expanded, thus giving at all times and in all positions a perfect contact.



THE SWITCHBOARD, AT THE NEW STATION, BOSTON.

By means of short-circuiting wires, leading from the field magnets of the dynamos to the switchboard, the current may be interrupted without causing the flash so injurious to contacts and so dangerous. In the above cut is represented the board. The lower line of switches is for the purpose of short-circuiting the fields, the first and fourth lines of connections are from the machines, while the second and third are from the circuits. All permanent connections are made in the small room at the back of the board. The circuits are led from the switch room to the tower on the roof, the summit of which is 110 feet from the sidewalk. From this trunk lines are carried to distributing towers in various portions of the city. The trunk lines are "cradled" by an ingenious device, which not only prevents danger from other wires falling on them, but also prevents them from falling on adjacent wires. The great height at which the wires leave the station allows the lines to be carried almost without exception above all other wires. The trunk lines are of No. 4 wire, service lines of No. 6. The lights are run in "circuits" of twenty-five each, and by means of the switchboard, described above, it is possible to instantly connect any circuit of lights with any dynamo in the station, and in the event of an accident to any engine or dynamo, or to the wires of any circuit, to instantly transfer its light to another machine Thus, there would be no possibility of more than one or two circuits (twenty-five or fifty lights) going out, even should an engine become disabled, and, as stated above, they would be transferred in a moment to another engine, so that their extinguishment would be for an instant only. Of course no such thing as the extinguishment of all the lights, or any considerable portion of them, would be possible, as some persons have supposed, through want of knowledge of the system of running the circuits.

On the second floor of the building, reached from Congress street by a broad stairway at No. 197, are the general offices, storerooms, and workshop of the American Electric and Illuminating Company, the "parent," or construction company, by which the lighting plant in the basement and lower story was put in, and which has, during the past year, built and supplied more electric-lighting plants in the New England States than all other companies combined. The visitor, ascending the stairs, turns to the left at the head of the first flight, and enters a large room, lighted by a powerful Thomson-Houston arc-lamp. A light rail separates the inner part of this room from the portion first entered, and inside this rail is a commodious library and reading-room, where are kept in suitable cabinets and file-cases books, papers, and publications relating to electrical subjects, in charge of a librarian, who also receives all visitors, ascertains their business, aad directs them to the proper offices. Here, also, is the desk of the clerk in charge of the stores and supplies, which are kept in the large rooms on the same floor, extending through to the rear of the building, on Leather Square.



THE BOILER ROOM, AT THE NEW STATION, BOSTON.

Along the Congress street front, entered from the library and reception room, are three offices, separated from each other and from the room just described by partitions of ground-glass and wainscoting. The central

room is the general business office, where are the desks of the transfer and dividend clerks and other office workers, and the counter for general business; the southern room is occupied by the treasurer, H. E. Irvine, Esq., and his clerical force; and the northern room is the directors' room and private office of the president and general manager, Mr. Edward H. Goff. All these offices are heated by steam, neatly carpeted, furnished, amply lighted, and supplied with toilet facilities. Electric bells and speaking tubes connect Mr. Goff's desk with those of all his subordinates, and a telephone in his desk connects with the exchange system of the city, enabling him to converse with any telephone subscriber, or to summon any of his assistants without rising from his chair. The two floors above will be occupied by the offices, laboratory, and work-rooms of the Electric Development and Manufacturing Company. The work has been planned and executed by and under the personal supervision of Mr. Fred M Kimball, constructing engineer of the American Electric and Illuminating Co.

The Theory of Magnetism.*

BY PROF. D. E. HUGHES, F.R.S.

The theory of magnetism which I propose demonstrating this evening may be termed the mechanical theory of magnetism, and like the now well-established mechanical theory of heat, replaces the assumed magnetic fluids and elementary electric currents by a simple symmetrical mechanical motion of the molecules of matter and ether. That magnetism is of a molecular nature has long been accepted, for it is evident that, no matter how much we divide a magnet, we still have its two poles in each separate portion; consequently we can easily imagine this division carried so far that we should at last arrive at the molecule itself possessing its two distinctive poles; consequently, all theories of magnetism attempt some explanation of the cause of this molecular polarity and the reason for apparent neutrality in a mass of iron.

Coulomb and Poisson assume that each molecule is a sphere containing two distinct magnetic fluids, which in the state of neutrality are mixed together, but when polarized are separated from each other at opposite sides; and in order to explain why these fluids are kept apart, as in a permanent magnet, they had to assume, again, that each molecule contained a peculiar coercive force, whose functions were to prevent any change or mixing of these fluids when separated.

There is not one experimental evidence to prove the truth of this assumption; and as regards coercive force, we have direct experimental proof opposing this view, as we know that molecular rigidity or hardness, as in tempered steel, and molecular freedom or softness, as in soft iron, fulfill all the conditions of this assumed coercive force.

Ampère's theory, based upon the analogy of electric currents, supposes elementary currents flowing around each molecule, and that in the neutral state these molecules are arranged haphazard in all directions, but that magnetization consists is arranging them symmetrically.

The objections to Ampère's theory are numerous. 1st. We have no knowledge or experimental proof of any elementary electric currents continually flowing without any expenditure of energy. 2nd. If we admit the assumption of electric currents around each molecule, the molecule itself would then be electro-magnetic, and the question still remains, What is polarity? Have the supposed electric currents separated the two assumed magnetic fluids contained in the molecule, as in Poisson's theory? or are the electric currents themselves magnetic, independent of the iron molecule?

In order to produce the supposed heterogeneous arrangement of neutrality, Ampère's currents would have either to change their position upon the molecule, and have no fixed axis of rotation, or else the molecule, with its currents and polarities, would rotate, and thus be acting in accordance with the theory of De la Rive. 3d. This theory does not explain why (as in the case of soft iron) polarity should disappear whenever the exciting cause is removed, as in the case of transient magnetization. It would thus require a coercive force in iron to cause exactly one-half of the molecules to instantly reverse their direction, in order to pass from apparent external polarity to that of neutrality.

The influence of mechanical vibrations and stress upon iron in facilitating or discharging its magnetism, as proved by Matteucci, 1847, in addition to the discovery by Page, 1837, of a molecular movement taking place in iron during its magnetization, producing audible sounds, and the discovery by Dr. Joule, 1842, of the elongation of iron when magnetized, followed by the discoveries of Guillemin that an iron bar bent by a weight at its extremity would become straight when magnetized, also that magnetism would tend to take off twists or mechanical strains of all kinds, together with the researches of Matteucci, Marianni, De la Rive, Sir W. Grove, Faraday, Weber, Wiedermann, Du Moncel, and a host of experimenters, including numerous published researches by myself, all tend to show that a mechanical action takes place whenever a bar of iron is magnetized, and that the combined researches demonstrate that the movement is that of molecular rotation.

De la Rive was the first to perceive this, and his theory (like those of Weber, Wiedermann, Maxwell and others) is based upon rotation. Their theories, however, were made upon insufficient data, and have proved to be wrong as to the assumed state of neutrality, and right only where the experimental data clearly demonstrated rotation.

I believe that a true theory of magnetism should admit of complete demonstration, that it should present no anomalies, and that all the known effects should at once be explained by it.

From numerous researches I have gradually formed a theory of magnetism entirely based upon experimental results, and these have led me to the following conclusions:

1. That each molecule of a piece of iron, as well as the atoms of all matter, solid, liquid, gaseous, and the ether itself, is a separate and independent magnet, having its two poles and distribution of magnetic polarity exactly the same as its total evident magnetism when noticed upon a steel-bar magnet.

2. That each molecule, or its polarity, can be rotated in either direction upon its axis by torsion, stress, or by physical forces such as magnetism and electricity.

3. That the inherent polarity or magnetism of each molecule is a constant quantity like gravity; that it can neither be augmented nor destroyed.

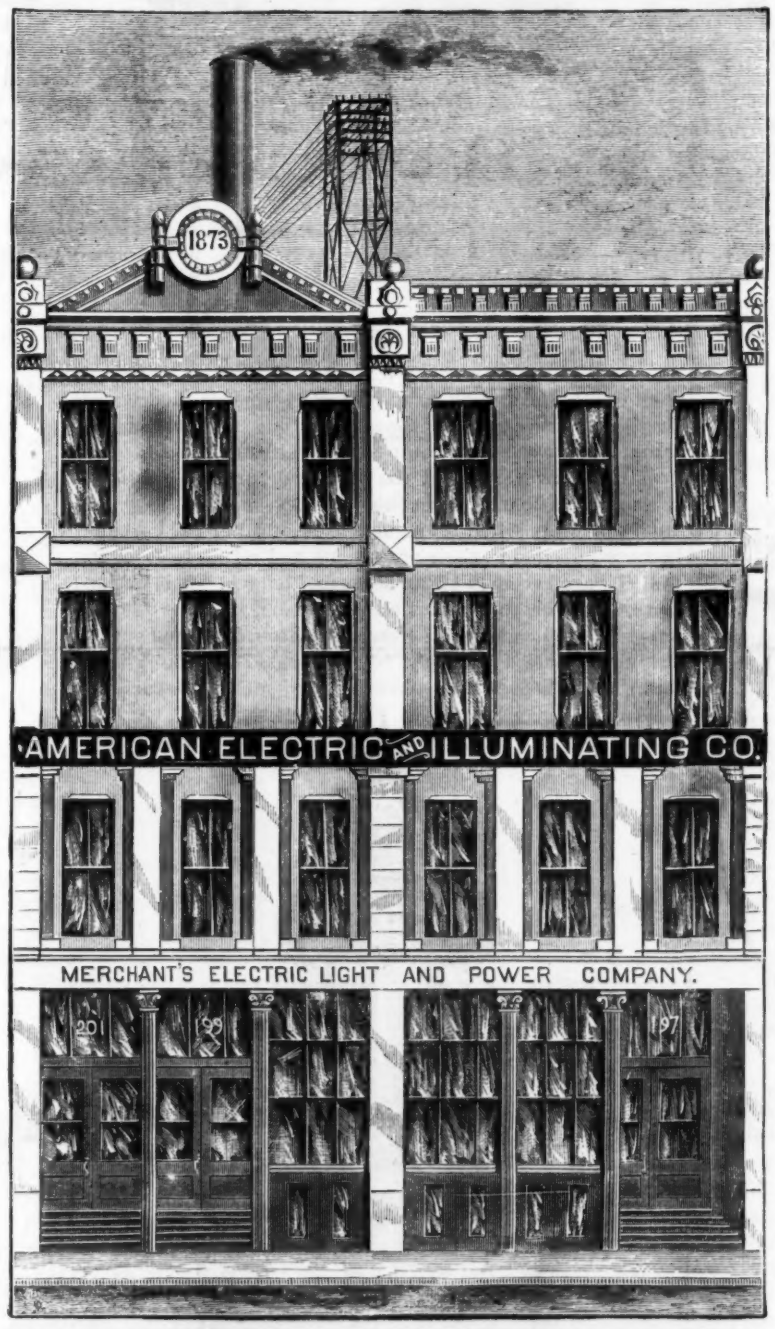
4. That when we have external neutrality, or no apparent magnetism, the molecules or their polarities arrange themselves so as to satisfy their mutual attraction by the shortest path, and thus form a complete closed circuit of attraction.

6. That when magnetism becomes evident, the molecules or their polarities have all rotated symmetrically, producing a north pole if rotated in a given direction, or a south pole if rotated in the opposite direction. Also, that in evident magnetism, we have still a symmetrical arrangement, but one whose circles of attraction are not completed except through an external armature joining both poles.

6. That we have permanent magnetism when the molecular rigidity, as in tempered steel, retains them in a given direction, and transient magnetism whenever the molecules rotate in comparative freedom, as in soft iron.

(TO BE CONTINUED.)

*Paper read before the Royal Institution, 29th February, 1884



EXTERIOR OF THE NEW STATION AND OFFICES, BOSTON.

The Production of Atmospheric Electricity.

At a recent meeting of the Paris Academy of Science the following interesting theory as to the production of atmospheric electricity was put forward by M. de Tromelin:

"The wind in grazing the surface of the sea carries with it the aqueous particles of the crest of the waves, which here play the part of the comb in Armstrong's machine. The roughnesses on the surface of the soil play the same part when a moist wind blows over them. These particles of water retain their electricity, and rising in the atmosphere form clouds, and as electricity passes to the surface of bodies, they tend to spread over the highest atmospheric surfaces; and I hold, with M. Faye, that the cirrus must retain great part of this electricity. That being admitted, it may be conceived that a cloud is electrified if formed in the conditions just cited. It would not be the case with a cloud formed by mere vapors rising in the air in the morning. But to produce lightning there must be a discharge between the cloud and another point, the earth or cloud, such that the difference of potential between the point and the cloud, at the moment in question, is sufficient to produce the lightning. But the distance across which the spark passes depends on the *electric pressure* and on the mechanical resistance which the medium presents to the discharge. This pressure varies with the square of the potential of the cloud, its form, its surface, the charge of the cloud, and its distance from the point in question. But the potential energy of a cloud depends on its form, its surface, and its temperature. When this cloud, originally electrified, undergoes any change whatever (condensation, congelation of aqueous vesicles, &c.), it absorbs a certain amount of energy, which should be found in the form of an increase of potential energy. This consequence results from the principle of the conservation of energy, and from Carnot's principle from which Lippmann has deduced such remarkable results. If, then, we suppose that the charge of the cloud remains constant for a certain time, condensation or lowering of temperature will increase the potential of the mass. During a storm it is very exceptional when there are no electrical manifestations. The abundant condensation then observed is the cause of an increase of potential of the storm-cloud, and when this potential is sufficient, discharge takes place in the form of lightning. Moreover, the continued renewal of the charge indicates that the cause must reside in the storms themselves. Air being a dielectric, the vapor becomes the natural reservoir of the electricity. Imagine a mass of electrified aqueous vapor in suspension in the air. At night, when the sun has disappeared, there will be a cooling of the cloud-mass. For the reason above given its potential will increase. Now, if the potential reaches a certain extent, the vesicles considered separately can no longer retain their charge—that is to say, they will escape into the air in the form of silent discharges. It is calculated that, at the ordinary pressure, a small sphere, 0.6 millim. in diameter, cannot retain electricity at the potential obtained with our ordinary machines. From the small radius of the vesicles it will be seen that a cloud cannot retain a charge at a potential exceeding a certain amount. In this way would be produced the phenomenon known as heat lightning. As these lightning flashes are seen by different observers in the horizon, it is logical to suppose that they are also produced at the zenith, and that they are not the reflections of the lightning due to storms at a distance. A similar phenomenon occurs with a traveler who always sees a layer of fog towards the horizon, while the sky above is clear. This is only due to a different thickness of the layers traversed by the visual rays."

T. M. B. A.—An assessment, No. 174, has been made of $1 to meet the death claim of P. P. Hauff. The claim under the certificate of O. H. Booth will be met from surplus.

AN ELECTRIC RAILROAD UNDER THE THAMES.—Work is now being rapidly pushed on the Charing Cross and Waterloo Road, which will run from the Waterloo Station of the London and Southwestern Railway to Charing Cross, a distance of 5 furlongs and 2 chains. The capital of this road is £100,000, or 10,000 shares of £10 each, and the company can only use electricity as the motive power. The road passes under the Thames in a tunnel which is now being dug. This work, with that of the underpinning necessary along the line, makes it a difficult piece of engineering, but it will be finished as soon as possible. The Siemens have taken a contract to operate this road for a year. A third company, with a capital of £500,000, has laid out four new short routes of electric railroads in London. These roads are to be fitted up with handsome cars, and the Siemens dynamos will furnish the current.

The Pilsen Electric Lamps.

(CONCLUDED FROM PAGE 91.)

The cut-out of the Pilsen lamp operates in reality by reducing the total resistance of the shunt or derived circuit around the arc, and not by sending the current past the lamp through a new circuit of low resistance. Of itself the armature of the cut-out magnet, as it falls back when it ceases to be attracted, performs only a simple function, that of short-circuiting the fine wire of the solenoid included in the derived circuit around the arc. But this fine wire constitutes nearly the whole resistance of the derived circuit, as is usual in differential arc lamps, and consequently when it is short-circuited the derived circuit becomes a path of low resistance through which the current can pass instead of going through the arc. The derived circuit now includes only the layer of large wire of the shunt solenoid and the German silver wire, the total resistance of both being equal to that of the arc, as stated in the previous article. We may suppose, therefore, that for an instant after the armature of the cut-out magnet has short-circuited the fine wire solenoid, the current is divided equally between the derived circuit and through the arc, since the two paths are of equal resistance. This increased diversion of current from the arc by the

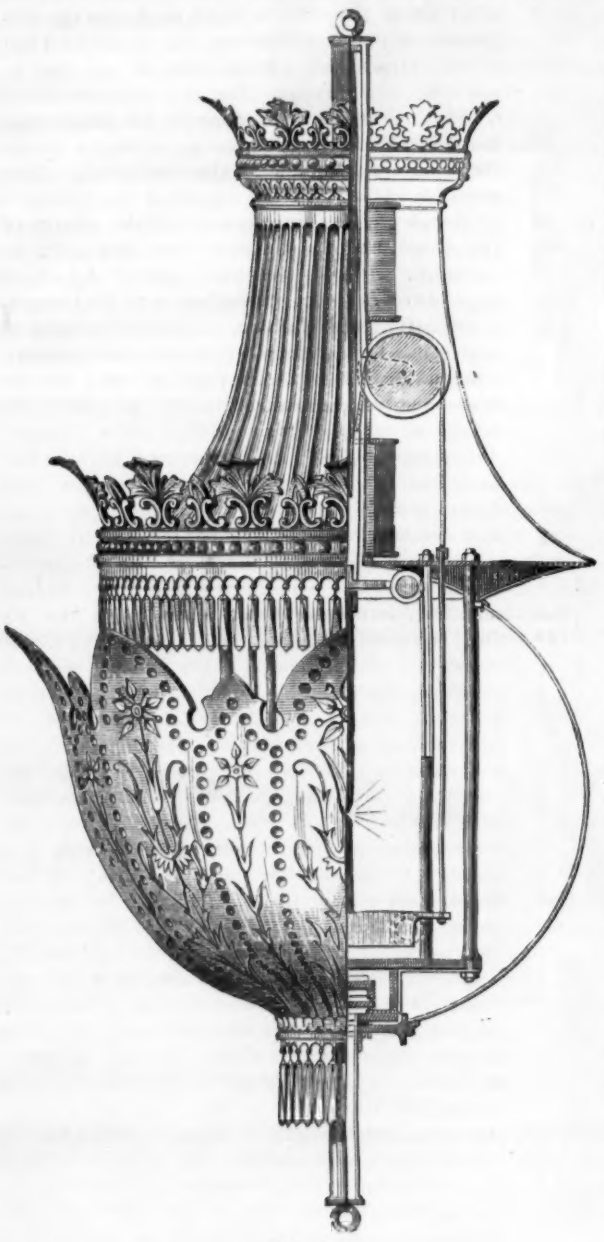


FIG. 14.

derived circuit would suffice of itself, as a rule, to cause the arc to be extinguished, but the result is made sure by the separation of the carbons, which takes place at this instant. The separation of the carbons, which thus intervenes at the right moment to complete the operation of cutting out the lamp, is explained by the fact that as soon as the fine wire of the shunt solenoid is short-circuited the upward pull exerted by the main circuit solenoid preponderates over the downward pull exerted by the single layer of large wire remaining in the derived circuit solenoid. It is thus seen that the current passing through this large wire is as strong as that in the main circuit solenoid, the current being divided equally between the two paths, as just stated; but as there are several layers in the main circuit solenoid its attractive power is necessarily greater. The core is therefore pulled upward until the arc is broken, after which the current ceases to pass through the main circuit solenoid, the only path left for the current being through the derived circuit. The attractive power of the single layer of large wire now causes the core to descend and bring the carbons together, though the arc is not formed, for in this situation, as already shown, the lower carbon holder touches the insulated piece by which current is excluded from the cut-out magnet. Thus it is seen that in the Pilsen cut-out the short-circuiting of the fine wire of the derived circuit solenoid is utilized in two ways: First, by reducing the resistance of the derived circuit to the extent of making it divert the current from the arc, and, second, by permitting the separation of the carbons, which insures the rupture of the arc. If the carbons break by the heat of the arc, or if the arc is blown out or otherwise exttnguished, the armature of the cut-out instantly falls back and the current is shunted, without causing interruption to other lamps in series in the same circuit. The layer of large wire in the shunt-solenoid

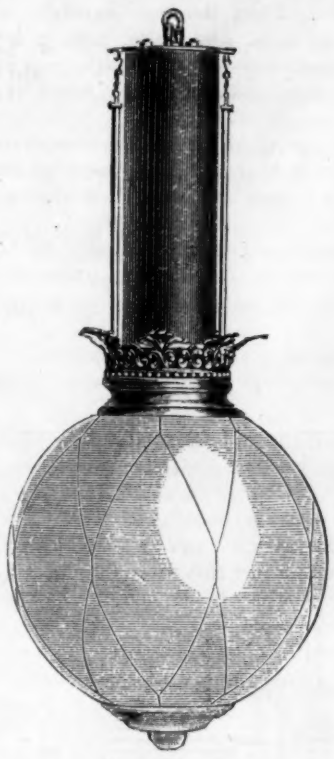


FIG. 15.

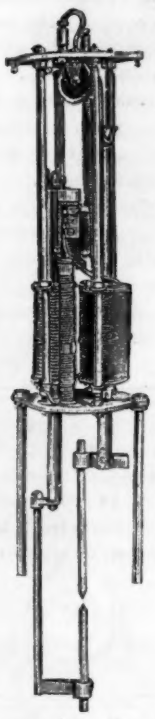


FIG. 16.

then causes the carbon to move together again, and when they come into contact the cut-out magnet attracts its armature, allowing the lamp to relight itself. This cut out does not, however, fulfill the principal function ascribed to an automatic cut-out in this country, namely, to "cut out" the lamp, when for some reason or other the carbons become impeded in their movement and refuse to feed, so that the arc becomes of an abnormal length. It is fair to state, however, that this trouble—which, in other lamps, arises from clogging of the escapement or derangement of the clutch—need scarcely be anticipated in the Pilsen lamp, which is devoid of all such complication, the carbons

FIG. 17.

and their holders counterbalancing each other, so that the motion is entirely free.

In lamps of the type last described the upper portion, containing the regulator, is inclosed in a casing of sheet metal, as is done with many types of arc lamps here. The globe is put on from below, and is large enough to fit around the suspension rods. It may be put on or removed without interfering with the operation of the lamp. This type of Pilsen regulator can be made to assume a very ornamental appearance if desired. Fig. 14 shows one of these ornamental Pilsen lamps adapted for use in theatres, halls or other decorated interiors. The left-hand portion shows the ornamental globe of frosted and cut glass, with overhanging coronet of polished metal, from which dangle a row of prisms, the casing being also crowned with a similar coronet. The regulator is shown in part by the section on the right side of the figure.

In the latest type of Pilsen regulator (Fig. 16), the arrangement of parts is somewhat altered though the principle involved remains exactly the same. The two solenoids are placed side by side, and the double-coned core is replaced by two single-coned cores, one for each solenoid, the arrangement being indeed the same as if the regulator already described were bent in two. Each solenoid is held between two slender metallic rods extending from the top to the base plate of the regulator frame. These rods serve also as guides for the brass tube inclosing the single-coned core that works up and down through each solenoid. For this purpose the upper portion of each tube is made with a cross arm, at either end of which is a grooved roller that rests against one of the rods. One end of the cross arm is provided with a small supplementary roller that is pressed against one of the rods by a spring to insure electrical contact. The lower portion of each core tube is guided by passing between three small contact rollers placed below each solenoid.

In this arrangement each core tube becomes a carbon carrier; the upper carbon is held as before, in a clamp attached to one core tube and provided with means for lat-

FIG. 18.

eral adjustment, and the lower carbon is carried by a bent arm prolonged downward from the lower end of the other tube, as will be readily understood from Fig. 16. The two core tubes are both suspended from the ends of a silken cord which passes over a pulley in the upper part of the lamp, as shown in the figure. Consequently the weight on one side counterbalances that on the other, so that the slightest preponderance of magnetic attraction on either core will cause the carbons to move. In the figure the main circuit solenoid is shown at the left, and the shunt solenoid at the right. The electrical connections are the same as in the lamp described.

The current enters the lamp at the top by the positive binding post, which is in electrical connection with the two guide rods on the right side. These rods convey the current to the tube that carries the upper carbon. After passing through the arc the current divides into two portions. A part leaves the left hand core tube by the three guide rollers, between which this core slides, and it passes through a resistance wire of iron coiled on a wooden rod, which is shown in the figure. The rest of the current leaves the core tube through one of the rollers at its upper end to pass to one of the guide rods, and from this through the cut-out magnet. There is a piece of insulation on this guide rod near the upper end, so that the current becomes excluded from the cut-out magnet as soon as the core tube has moved up to this point, which occurs when the carbons are nearly or entirely consumed. The two currents then reunite to pass through the main circuit solenoid which connects with the negative binding post. The current diverted through the derived

circuit around the arc leaves the right-hand core tube at the guiding rollers to pass through the shunt solenoid and through the German silver resistance wire that connects with the negative binding post, a connection being made with the contact screw of the cut-out magnet at the point of junction between the large and fine wire of the shunt solenoid.

The two conical cores point downward, and as the lamp appears in Fig. 16, with long carbons in place, the left-hand core is nearly inside the main circuit solenoid, while the right-hand core is pulled up almost entirely out of the shunt solenoid. Supposing the carbons to be in contact, when the current is sent through the lamp, the main solenoid pulls upon the left core, causing the carbons to separate until enough current is diverted through the shunt solenoid to establish a balance. The undue separation of the carbons is prevented in this case as in the previous form by a pawl which engages the teeth on the rim of the pulley. As the carbons consume the shunt solenoid will preponderate in power and pull on the right core until the carbons have moved together to the required extent, whereupon the solenoids again balance each other and the carbons stop moving. This occurs every time the arc increases in length, and when the carbons are consumed the insulated piece in the guide rod is reached by the roller and the lamp is cut out from the circuit.

Thus it is seen that even although the biconical core is divided into two and each part is acted upon independently, the same results are obtained, in this new form of regulator, which has the advantage of being more compact and somewhat less complicated. The regulating apparatus is inclosed as before in a japanned metallic case, and the globe, which is surmounted by a handsome coronet of polished brass, is fitted around the carbons, the lamp presenting the neat appearance shown in Figs. 15 and 18. The difference between the two forms shown in these figures is due to the manner of supporting the globe. The lower opening in the globe is closed by a cup-shaped cover, the "ash pan." In the first form (Fig. 15) there are two long rods projecting vertically from this ash-pan, each provided with a hook, or a ring, at its upper end. The two arms projecting downward from the base plate of the regulator in Fig. 16, and which appear like the suspension arms with their lower portion removed, are in reality hollow. The rods which are intended to support the globe pass through these arms and are hooked to the top of the lamp on either side (Fig. 15) or the hollow arms may be dispensed with and the rods then pass through the ears in the base plate. To lower the globe for the purpose of changing the carbons the two rods are unhooked and the globe is allowed to slide down until the hooks or rings rest against the base plate of the regulator.

In the second form (Fig. 18) the suspension arms are prolonged down and joined by a crosspiece at their lower extremities, as is usually the case in other arc lamps. The "ash pan" is bored through the centre, and it can slide up and down on a stem projecting downward from the middle of this crosspiece. The ash pan carrying the globe is held up in place by a pin inserted into the stem which prevents its sliding down. Whenever it is desired to lower the globe a rod is screwed into the lower end of the stem so as to prolong it downward, as shown in Fig. 18. The pin is then removed and inserted at the lower end of the rod, after which the globe is allowed to descend until the ash pan rests against the pin.

The Pilsen regulator of the type shown in Fig. 16, can be made ornamental with as good effect as the earlier type. Fig. 17 shows one of these ornamental Pilsen lamps, ten of which were exhibited by M. M. Piette and Krizik, at the Vienna exposition. The metal work is of copper and bronze, and it forms a frame for six large oval panes of ground glass. By giving to these panes a convex form the rays of light are made to diverge in passing through them. It results that the rays from the contiguous panes intercross each other and consequently the ribs of metal between the panes, although of considerable width, cast no shadows. By placing reflectors along these ribs the rays of light which they would otherwise intercept are reflected out through the opposite panes, so that little or no light is lost. The lower part of the lamp is also provided with small hemispherical panes through which light passes out. These lamps were used to light the Austrian Telegraph exhibit at the Vienna exposition, and they were greatly admired by the beautiful effect which they produced, a result to which the remarkable steadiness of feed, characteristic of the Pilsen regulator, must have contributed quite as much as the ornamental lamp itself. The inventors claim that a Pilsen ornamental lamp of this kind is not as costly a luxury as might seem, because the Pilsen regulator of itself is not of costly construction, since delicate workmanship is not required.

The principle of the Pilsen regulator is susceptible of application under other forms than those already described. Fig. 19 shows a regulator adapted for use with a reflector. In this case we have what is substantially an inverted form of the regulator just described (Fig. 15). The weight of the two cores counterbalance each other as before, being attached to a cord that passes over two pulleys near the top of the case. As both carbons necessarily feed at the same rate, while the arc consumes the positive carbon twice faster than the negative, the position of the arc will not remain the same, but it will be gradually displaced toward the positive carbon. However, the regulator may be made self-focusing with very little difficulty. For this purpose one of the pulleys is removed, and in its place two pulleys, fastened together, one being of twice the diameter of the other, are used. The silk cord is divided; the piece attached to the core that carries the positive carbon is fastened to the large pulley, and the piece attached to the core carrying the negative carbon is secured to the smaller pulley. It will be understood now that the feed motion of the positive carbon will be twice greater than that of the negative carbon, and consequently the arc will remain at the same focus. We might state that the regulator shown in Fig. 16 could also be made self-focusing by using two pulleys, one twice larger than the other, the ends of the cords being attached as in this case.

In all these forms of Pilsen regulator the motion of the core or cores is communicated to both carbons, by doing which the carbons are fed for a length equal to twice the range of motion of the cores. By making the lower carbon stationary, giving to the core moving the upper carbon a longer range of motion, MM. Piette and Krizik have succeeded in making an exceedingly simple regulator (Fig. 20). The upper carbon is clamped to a tube guided between rollers and inclosing a single-coned core of greater length than those used in the other types of Pilsen regulator. The main circuit and derived circuit solenoids are wound together so as to form a single solenoid *Y Z*, inclosing the core. The main circuit or large wire *Z* is wound so as to taper downward and the derived circuit or fine wire *Y* is wound over this so as to make the helix even, as seen in the figure. In this case the connection must be made in a particular way, such that the two portions of the solenoid act in opposition. When the current is sent through the lamp the current passes entirely through the main circuit solenoid, and the core is pulled upward, causing arc to be formed. Some of the current is thereby diverted through the shunt solenoid with the effect of counteracting the power of the main circuit solenoid, so as to weaken its attractive effect on the core, which then stops moving upward. When the arc increases in length the shunt solenoid becomes stronger still, and neutralizes the attraction of the main solenoid for the core, so that the latter falls down a trifle. This feeds the carbon, and as less current now passes through the shunt solenoid, the main solenoid holds the core in this situation until the arc increases again, and then the same process is repeated. The extreme simplicity of this form of Pilsen regulator and the entire absence of parts liable to derangement or requiring adjustment are great points in its favor. We might also add cheapness of construction as an important consideration in its favor.

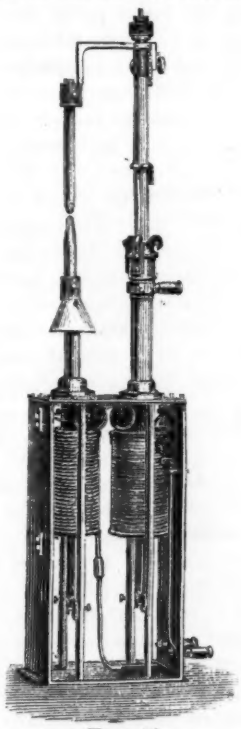


FIG. 19.

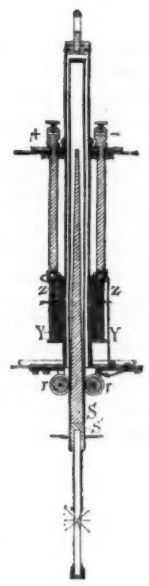


FIG. 20.

An interesting application, which has been made of the principle of the Pilsen regulator by MM. Piette and Krizik, is in the construction of current meters and regulators. For instance, an ampère meter may be made by means of a large wire solenoid and a conical core whose motion into the solenoid, under the influence of a current in the latter, is opposed by a weight or spring, the core being made to carry a pointer that moves over a graduated scale. The longer the core the greater the range in which the readings on the scale are proportional to the current in the solenoid. The same principle applies to volt meters, which differ from the ampère meters merely in the substitution of a solenoid of very high resistance for the large wire solenoid. Many of these ampère and volt meters have been used in Europe, and they have proved equal to any on the score of delicacy and accuracy.

The Pilsen regulators now being exhibited by Mr. Pfannkuche are of the standard type (Figs. 15 and 18) except one which is of the horizontal type. It is expected that a few of the simpler type (Fig. 20) will arrive shortly. Of the performance of these Pilsen lamps we feel warranted to speak with unqualified praise. The light they produce is white, pure, and, above all, perfectly steady. We watched the arc in some of them for nearly half an hour, and without detecting the least possible change in the distance between the carbon points. The shunt solenoid seems to be overbalancing the main circuit solenoid constantly, and by such a minute difference that the carbons are always moving, at *precisely* the rate at which they are consumed; they never lag in feeding, nor do they feed too far, for the arc remains uniform in length—in this case between three and four millimetres, as near as we could judge. The Pilsen lamps can, of course, be adapted for any current by varying the length and size of the wire used in the solenoids. These lamps were adjusted to run normally with a current of eight ampères, and, using Siemens carbons, were said to require a difference of potential of from 48 to 50 volts, the light emitted being estimated at 1,300 candles, measured at the best angle. The electrical energy consumed in each lamp would be about 400 watts according to this. The measurements of power show that this cannot be far from right. Five lamps were used, the current for which was produced by a dynamo-electric machine made by Mr. C. E. Ball, and the total power consumed, including friction, loss in transformation, etc., was found, by actual dynometric measurement, to be about three horse-power, or 0.6 horse-power per light. If we allow 10 per cent. for losses, which is not too much, in all probability, the expenditure of electrical energy per lamp becomes exactly 400 watts. As for the intensity of the light, though we did not make photometric measurements, we have no reason to doubt the accuracy of the figures above given, for the light was undoubtedly superior to that of the "2,000 candle power" light as we find it in the street circuits.

We have also had occasion to see a Pilsen lamp burning with incandescent lights fed by an Edison machine. In this case the difference of potential between the two leads was about 100 volts, and as only 50 volts were required the current, after passing through the lamp, was divided between ten 50-volt Edison lamps. This lamp worked very satisfactorily indeed, and maintained its arc steadily in spite of all changes produced by switching incandescent lights in and out of circuit.

The Pilsen incandescent lamp is worthy of mention in connection with this exhibit. The globe is made somewhat egg-shaped, and the filament which is of the U-form, is made from carbonized cotton thread. The platinum connecting wires which are sealed in the glass are prolonged somewhat further inside the bulb than is usually the case. They terminate in corkscrew twists into which the ends of the filament are inserted, the joint being then covered with a peculiar cement. The resistance of these lamps cold, is about 100 ohms, but it falls down to 45 ohms when they are hot. According to tests lately made by Prof. Jamieson, of Glasgow University, these lamps when burning at an intensity of twenty candle-power only require an expenditure of energy of from 48 to 54 watts. This electrical efficiency—nearly 14 lights per horse-power—is very remarkable. With a "Ball" compound dynamo-electric machine supplying 60 of these lamps, the candle power being apparently normal, the total consumption of energy was found to be about 5 horse-power. This would give 12 lights per horse-power, even assuming that all the power expended was utilized in the lamps, which of course was not the case. By making allowance for losses in transformation, internal resistance of machine, etc., the efficiency realized approximates very closely to that obtained by Prof. Jamieson.

The Joel "incandescence-arc" lamp, of which three were shown in operation, is a modification of the Werderman lamp, which attracted so much attention in Europe about four or five years ago. In this lamp, it will be remembered, a slender rod of carbon is urged upward by a counter-weight, and after slipping between two metal jaws it butts against a block of carbon, placed at a short distance above. It results that when connections are made with the metal jaws and the carbon block the short piece of carbon between them is rendered incandescent by the current. The carbon burns in a pointed form, being fed continuously by the weight, and a small arc is also produced around the point, hence the term "incandescence-arc," by which the light is designated. In the Joel lamp the same form is practically retained, though the details have been improved somewhat. The light produced by these lamps is peculiarly mellow and pleasing, recalling an arc light by its whiteness, and an incandescent light by its subdued intensity and steadiness. However, while we feel constrained to admire the beautiful light produced by these lamps, we doubt if they are very practical. The carbons not infrequently stick in the jaws owing to unevenness or some other cause, and as the carbon keeps on burning an arc is produced which is soon extinguished. Besides, if the carbon happen to break, owing to impurities, it presents a square end to the carbon block when it comes up under the influence of the weight, and this must burn until it is tapered to a point again before the light regains its normal intensity. The most fatal objection which these lamps have to contend with, however, is their low efficiency. They require a current of nearly 50 ampères with a difference of potential of about 12 volts. This means an expenditure of electrical energy of about 600 watts, while

the candle-power obtained is much below 200 candles. In other words, while they consume one half more energy than the Pilsen arc lamp they scarcely give one seventh of the light. They suffer by contrast even with incandescent lamps. The same energy expended in Pilsen incandescent lamps would give about 11 lamps or 220 candles, while the distribution of light realized would be incomparably better. In fact, we believe that five or six of these incandescent lamps properly disposed would be prefered to one of these "incandescence-arc" lamps.

In conclusion, we have to thank Mr. Pfannkuche for his courtesy in explaining details and in giving information regarding the lamps we have described in the above articles. We would also state for the benefit of electricians and others who are interested that these lamps may be seen in operation at the factory of Mr. C. E. Ball, Twenty-second street and Second avenue, this city. * * *

Magnetized by a Line Battery.

To the Editor of The Electrical World:

SIR: I see in your paper an account of a lineman's watch having been magnetized by a line battery.

A similar instance occurred here on March 5. Lineman Foster was repairing some trouble between here and Winona, the next telegraph station, and was leaning over one wire repairing another when suddenly there was a heavy current passed over the wire which not only magnetized but completely tore the works of his watch to pieces. He himself did not realize any shock at all. How do you account for this? I am not trying to "out yarn" the other man, but merely stating facts.

LUCIAN T. AUSTIN.

DUCK HILL, Miss.

The Age of Wire.

Future annalists may well describe this period of American history as the wire age, says the Boston *Advertiser*. In no part of the economy of our daily life are we divorced from wire. It is our slave, and yet an ever-present master. Sleeping, we repose on wire mattresses. Eating, we see foods that have passed through sieves and which are sheltered from insect appetite by wire covers. Calling, we pull wires to ring curled wire gongs. Traveling, we are conveyed by cable or electric railways, hoisted by elevators hung on wires, and hurried over wire bridges. We announce our coming by telegraph or telephone wires, and we thread our way by night through streets lighted by means of electric cables. Across our fields are strung many thousands of miles of barbed wire fences, against which dumb brutes protest, Texas rangers draw the knife, and lawyers, juries, judges and reporters whet their intellectual blades. Our clocks are set by wires, our watches are run by wires, our books are stitched by wire, our pictures are hung by wires, and our politics are managed by wires.

Underground Telegraph Wires in Philadelphia.

A dispatch of the 18th inst. from Philadelphia says that within the last two or three weeks the Pennsylvania Railroad Company has abandoned the use of all its overhead telegraph wires except two, which run between the Broad street station and the company's main office in South Fourth street and the freight station at Front and Walnut streets, and is doing its telegraph and telephone business between these points by means of underground wires. It is asserted that the company is using about 40 underground conductors with perfect success. In addition to the telegraph business three telephone wires running through the same conduits are already in successful operation. The correspondent of the New York *Times* claims to have chatted over a mile and a half of telephone wire laid underground, and says that it was the most satisfactory chat by telephone that he ever indulged in. There was not the slightest evidence of induction—the distressing buzz and rattle that is always heard when overhead wires are used, and sometimes renders intelligible communication absolutely impossible. The tones of the voice of the man at the other end of the wire were as clear and distinct as though he had been in the same room. The underground system which has been adopted by the Pennsylvania Railroad Company was invented by Mr. David Brooks.

The New Companies and the Conventions.

The Baltimore & Ohio and the Bankers & Merchants' Companies ought to see what advertisements they can get out of the forthcoming political conventions. The American Union got considerable glory at the time of the 1880 Republican Convention at Chicago and Democratic Convention at Cincinnati on account of its early announcement of the results. Readers of THE ELECTRICAL WORLD remember the claims made at the time; the denials and the charges of tall guessing. Now that the two companies are one, with many of those then prominently identified with the American Union now holding responsible positions with the Western Union, it will probably not be considered improper to tell how the American Union was enabled to announce Garfield's nomination so promptly.

It occurred in this way. The American Union had just got nicely ready for business. It wanted to attract public attention by doing something that would set the country to talking about it. After balloting had gone on unsuccessfully for some time a private telegram was handed in written by one of the delegates and addressed to G. W. Childs, of Philadelphia. This stated that Garfield would be nominated on the next ballot. Here was the opportunity, and advantage was taken of it. Of course it was appreciated that if Garfield was *not* nominated this previousness would be detrimental to the company; but, on the other hand, it was considered that this was pretty reliable information and that if it turned out to be correct the incident would give the company a big boom; so the risk was taken, and when it was thought time or nearly time for the ballot to be taken, the announcements, which had been prepared in the meantime, were simultaneously displayed at several points in the city and were also telegraphed to other points. Along came the Western Union announcement when Garfield had been nominated, but the American Union got all the credit.

This victory was followed up at Cincinnati, where the company had made elaborate preparation, and where it did excellent service. The two conventions, in fact, helped the new company very materially, and had no little effect in bringing it into prominence. The B. & O. and B. & M. may do well to see whether they cannot turn the forthcoming conventions to account, and by legitimate effort secure some little advertising out of them.

The Fight Between the Garrett and Gould Telegraph Companies.

We give below three important dispatches in which will be found the latest news with regard to the fight now being carried on between the Western Union and Baltimore & Ohio Telegraph companies.

CLEVELAND, O., March 15.

On March 1 the Western Union Telegraph Company secured a temporary injunction against the National Telegraph Company restraining the latter from interfering with any rights to the use of Nickel Plate telegraph lines which plaintiff had acquired the right to use under its contract with one McGourkey, builder and part owner of the same at the time the contract was made. The case was set for final hearing to-day, but by consent of the attorneys for the plaintiff and defendant the temporary injunction was continued in force until March 22, when the contract of the plaintiff with McGourkey terminates. In the interim the final hearing of the injunction proceedings of the National Telegraph Company against the Nickel Plate Railroad Company will be held before Judge Baxter in the United States District Court at Cincinnati, and as the points involved are very similar they will have much to do with the final disposition of the case of the Western Union and National companies.

The National, in its answer filed to-day, denies that the agreement between McGourkey and the Nickel Plate, made before the telegraph line was constructed, provided that McGourkey should do no telegraph business at points on that road at which the Western Union had offices, as stated in the petition for an injunction. It also denies that in violation of a contract made by McGourkey and the Western Union the National established offices at Buffalo and Cleveland, and threatened to immediately commence doing a commercial business in competition with the Western Union at Buffalo, Cleveland, Fort Wayne, and Chicago, and at other points on the Nickel Plate, where the Western Union has offices, and to deprive the Western Union of the benefits of that arrangement at all places to which it extends. "Neither is it true," says the National, "that the wires were by terms of the contract to be operated only by the Western Union." While it is true that offices have been opened at Buffalo and Cleveland, and wires are now being constructed along the Nickel Plate in pursuance with the agreement made with McGourkey, yet the National say that they do not propose to do any commercial business until after the expiration of the 60 days specified in the agreement.

SYRACUSE, N. Y., March 15.

Argument was heard before Judge Wallace, to-day, on a motion to dissolve an injunction in the case of the Western Union Telegraph Company against the Baltimore & Ohio Telegraph Company, the National Telegraph Company and the West Shore Railroad Company. The Western Union seeks to prevent the National Company from operating a competing line along the route of the West Shore road, and also seeks to prevent the Baltimore & Ohio Company in aiding it in so doing. The defendants claim that the Western Union make it a practice of obtaining contracts with all new railroad lines that are put down, and, after obtaining such contracts, put up a meagre and poorly equipped line of telegraph to bind the contract, and after a short time allow these lines to fall into disuse and decay, as they have done in the case of the Jersey City & Albany Company, the contract which is reviewed in these proceedings. The terms of its contract are such as to allow no other line of telegraph to be put up while its contract lasts. The Western Union entered into a contract with the Jersey City & Albany road for the purpose of setting up and operating a line of telegraph from Richfield Junction to Haverstraw, a distance of about 26 miles, and when the West Shore was built it was consolidated with that road. The Western Union proceeded to put up, and did put up, the defendants say, a poorly equipped line, which immediately fell into disuse. The defendants claim that when they commenced operating the National Line an injunction was served against them restraining them from action. The plaintiff, the Western Union, was represented by Gen. Wager Swayne and Burton N. Harrison; the defendant telegraph company by G. P. Lowery and Edward R. Bacon; the West Shore Railroad by M. M. Waters.

B. N. Harrison read affidavits from Superintendent Holmes, of the Western Union, and others. E. R. Bacon replied by reading affidavits from Charles Tappin, Superintendent of the West Shore and National Telegraph Companies, and the defendants have shown photographs proving that it does not interfere with the operation of a line to have another by its side. They have also exhibited maps of their line and also of the abandoned line of the Western Union. The counsel for the Western Union argued that its line was never abandoned. The Judge reserved his decision.

SYRACUSE, N. Y., March 27.

The attempt of the Western Union to prevent the Baltimore & Ohio Telegraph Co. from taking possession of the lines recently purchased by the latter from the National Telegraph Co. has failed. Judge Wallace to-day rendered a decision in favor of the defendants. This decision will enable the Baltimore & Ohio Company to secure through communication to Chicago by the West Shore and Nickel Plate routes in addition to its existing route via Pittsburgh. Additional wires will be immediately strung over the National Company's route, and offices will be opened for business in all the large cities in New York State.

Annual Meeting of the Bell Telephone Company.

The annual meeting of the Bell Telephone Company was held at the Meionaon, Boston, on the 25th inst., and was very largely attended. Mr. William H. Forbes presided. The clerk, Mr. Charles E. Hubbard, read the call and the records, and Mr. Forbes read the report of the directors, which was accepted and placed on file after a vote that it be printed and mailed to the stockholders. The treasurer's statement was also presented and accepted. The proposition to change the time of the annual meeting from the last Tuesday of March to the third Tuesday of February was not acted upon. A resolution appointing a committee to report upon the various controversies in which the Bell Company is at present engaged was tabled. The following officers were elected: Directors, Francis Blake, Charles P. Bowditch, Charles S. Bradley, George L. Bradley, Channing Clapp, Alexander Cochrane, William H. Forbes (president), Charles Eustis Hubbard, Gardiner G. Hubbard, Robert B. Minturn, William G. Saltonstall, Thomas Sanders; treasurer, William R. Driver; clerk, Charles Eustis Hubbard.

The following is a summary of the report of the directors: The growth of our business for the past year has been healthy, and in some directions very active. The demand for new telephones fell off during the winter months, but the net output for the year was 57,299, against 60,337 for the previous year. The number of miles of wire in use has increased during the year from 13,653 to 29,359. Since the last report 165 new exchanges have been built, 13,417 miles of new wire added in the exchanges, and 25,798 new subscribers connected. The treasurer's statement for the year ending Feb. 29, 1884, shows that the gross earnings of the year were $2,295,594.07, and the net earnings $1,475,431.37, as against $972,044.28 the year before, an increase of $503,000. Adding balance of income from previous year and miscellaneous credit items, we have a total of $1,734,804.78, out of which dividends have been paid of $1,051,479, $334,441.61 carried to surplus account, leaving a balance to our income account of $348,884.17. Our chief source of revenue is still from rental of telephones, the receipts of which were $1,695,678.58. The dividends upon our stock in licensed companies amount to $440,923, an increase of over $200,000. The income from extra territorial lines was $45,819.68. In addition to the cash purchase of interests in local companies, $9,998,850 has been received in the stock of those companies for licenses issued, and our holdings in those companies now amount to about $19,000,000. In Canada the Bell Telephone Company's affairs are in good condition, and 6 per cent. dividends are paid upon its capital of $1,000,000. Construction expenditures to the extent of some $100,000 must be provided for these.

Other important points are dealt with as follows: The tendency toward consolidation of telephone companies noticed in our last report has continued and is for the most part in the interest of economical and convenient handling of the business. It is common to see in the public papers round statements that the wires ought to be at once ordered underground. In this matter we and our associates have the strongest motives for wishing to get wires underground as far and as soon as it can be done without destroying the efficiency of the service. But although short trunk lines work fairly well beneath the surface, as shown in Boston and elsewhere, in the present state of the art it is impracticable to put the bulk of the wires underground without interfering seriously with facilities upon which the public are now getting to depend. Conversation over long lines (those reaching the suburbs even) is difficult and often impossible to those who are connected through the underground cables. The number of connections in the United States is now estimated as at the rate of 215,280,000 per annum or 4.85 per subscriber per diem. The cost of

these connections varies from 2½ cents to 5½ cents each. It is estimated that 29,000 miles of extra territorial wire are now giving 5,220 connections per day or 1,879,200 per annum. The average rate for distances inside of 35 miles is 25 cents, for which at least 100 words each way can be had if desired, with all the advantages of immediate response. The average rate to the public at telephone toll stations for short circuits is 15 cents. The average price of telegraph messages in the United States is 38 cents and for distances inside of 35 miles about 20 cents, and the rate for short circuits is about 15 cents. Especial attention is being given to long line service, and we have just built a line between Boston and New York, now almost ready for trial.

This table is furnished of Exchange statistics for the last two years:

STATISTICS.

	Jan. 1, 1883.	Jan. 1, 1884.	Increase for the year.
Exchanges in operation	735	890	165
Miles of wire on poles	54,146	70,171	....
Miles of wire on buildings	15,306	12,708	....
Total miles of wire	69,452	82,879	13,427
Number of circuits	74,737	97,184	22,447
Number of subscribers	97,735	123,533	25,798
Number of branch offices	345	419	74
Number of employés	3,704	4,777	1,073

EXTRA TERRITORIAL LINES.

	Jan. 1, 1883.	Jan. 1, 1884.	Increase for the year.
Licenses issued	256	432	176
Miles of pole lines	6,154	20,592	14,438
Number of wires	13,653	29,359	15,706

INSTRUMENTS.

	Feb. 20, 1883.	Feb. 20, 1884.	Increase for the year.
In hands of licensees under rentals	249,711	307,010	57,299

REVIEWS OF NEW BOOKS.

NOTES ON ELECTRICITY AND MAGNETISM. Designed as a Companion to Sylvanus P. Thompson's Elementary Lessons. By J. B. Murdock, Lieutenant U. S. Navy. 12mo, 139 pp. Macmillan & Co., New York. 1884. Price 60 cents.

These notes are valuable additions to Prof. Thompson's well-known Lessons in Electricity and Magnetism, as they convey supplemental and explanatory information to assist the student in his use of this already standard textbook. The tables and formulas are well presented and are needed to fill the places assigned them by the author. The fault which we might find is that the author does not, in his elucidations, always adhere to the specific symbol-letters used by Prof. Thompson in the equations he explains or enlarges upon. It is well for authors not to use unlike symbol-letters to designate any one unit or value; as, for instance, *C*, *S*, *I* or *Q* for strength of current, or that factor of electric energy for which we use the practical unit ampère. Such indiscriminate use of symbols, especially in one reference or connection, is unnecessary complication which tends to confusion in the student's mind.

K.

DEPARTMENT OF INQUIRIES.

43. AMALGAMATION AND WINDING.

Is amalgamated zinc better adapted for Leclanché cells than plain zinc? Is iron wire as serviceable for electro-magnets as copper wire? If so, why is it not more extensively used? If instead of winding a helix from right to left, and winding the next layer from left to right, as usually done, I were to wind from right to left and then lay the wire in a straight line back from left to right and repeat this until a certain quantity of wire was disposed of in this way, would such a coil be as well suited for electro-magnets or induction coils as a coil wound in the ordinary way?

H. F. H.

EAST CAMBRIDGE, MASS.

As there is no free acid in the Leclanché solution (sal-ammoniac) the zinc is not attacked while the circuit remains open, and there is consequently no absolute necessity for amalgamation. However, the amalgamation of the zinc prevents the incrustations of crystals which usually form on the zincs of Leclanché cells that have been in use for some time. These crystals diminish the available acting surface, and thereby cause an increase of internal resistance.

Wire made of any metal may be used for winding electro-magnets, and taking two electro-magnets, one wound with iron wire and the other with copper wire of the same length and size, both will have the same attractive power, when the current passing through one is of the same strength as that passing through the other; but it will take more cells of battery to produce a given strength of current in the case of the iron-wire magnet than it will with the copper-wire magnet. This is because the resistance of iron for the same length and size, that is to say, its *specific* resistance is higher than that of copper—usually 5.63 times, though in some grades of iron it may be even higher. To express the difference more plainly, we could replace the iron-wire magnet by nearly six (5.63) of the copper-wire magnets and the current would remain of the same strength; or we could use one magnet containing all this wire. In other words, the same current energy will produce 5.63 times more magnetic effect with copper wire than with iron wire. The method of winding proposed would not be as satisfactory, because the portions of wire run back in a straight line would not be effective, and, besides, they would cause ridges in the succeeding layers. The winding would be more uneven, but the wire would not be packed so closely to the iron core. The present mode of winding is in all respects preferable.

***

THE TELEGRAPH.

INCREASING ITS CAPITAL STOCK.—The Bankers and Merchants' Telegraph Company gave notice to the Stock Exchange on the 20th of a contemplated increase of its capital stock to $3,000,000. This will involve an issue of $1,000,000 of new stock.

TO MEET ITS RIVALS' CUTTING.—The Western Union Telegraph Company has reduced its rates on business between the Philadelphia & New York exchanges to 10 cents for each 10 words. This reduction, it is explained, is for the purpose of meeting the rate made by rival lines.

ELECTION OF OFFICERS.—At the annual meeting of the stock holders of the Mutual District Messenger Company of Washington, held at 46 Bond street, March 19, the following officers and directors were elected: W. F. Chester, President; W. F. Allen, Secretary and Treasurer; W. H. Woolverton, W. F. Allen, G. F. Truell, M. Riebenack, C. E. Pugh, H. W. Pope, C. H. Sewall, W. F. Chester and H. McGonegal, Directors.

"A TRICK OF THE MACKAY COMPANY."—Representative Budd, of California, appeared before the House Post-office Committee on the 19th at Washington, and argued that the proposed contract of the Postal Telegraph Company was defective in form and substance; that it was a trick of the Mackay Company, and was introduced for the sole purpose of preventing the passage of the Sumner bill establishing a government telegraph, a bill for the passage of which there was, he said, a universal demand.

THE POSTAL CO.'S LINES.—Vice-President Cummins, of the Postal Telegraph Company, stated on March 22 that the company had completed 2,200 miles of pole line and would open the lines to St. Louis probably on Thursday or Friday. "We now have our lines working to Philadelphia, Baltimore and Washington," he said, "and business will be begun between here and Buffalo, Pittsburgh and Toledo in a few days. Our first cable will be in working order by Aug. 1, should no accident prevent. We had expected to send our first message across the ocean on the Fourth of July, but the accident to the cable steamer of course caused a slight delay."

INTENTIONS OF THE CANADIAN PACIFIC.—A report that the Canadian Pacific Railway Company is about to enter the lists as a competitor for telegraphic business is confirmed, says the Montreal *Witness*, on good authority. The company, as is well known, has long been taking public messages on its lines in the Northwest. The new departure will simply mean the extension of this practice to the older provinces. Ultimately telegraphic correspondence will be established by the company's route between Montreal and Winnipeg, thus competing with the Western Union, which takes messages to the Northwest round by St. Paul. It is also said that the Canadian Pacific authorities, in pursuance of this policy, are negotiating for cable connections with Europe. The question, in case they really wished to compete for transatlantic telegraphic business, would be whether the company could legally work a line from Montreal to New York. This, as an official of the company remarks, is a matter for the lawyers to settle.

A POSTAL TELEGRAPH BILL.—The sub-committee of the Senate committee on post-offices, having several postal telegraph bills under consideration, has at last formulated a bill, of which the following is an abstract: The postmaster-general shall establish telegraph offices at all the post-offices on telegraph circuits, and at all other post-offices within 10 miles of any such circuit where the salary of the postmaster is not less than $500 per annum. The postmaster-general shall provide telegram stamps and stamped paper of suitable denominations to be sold as postage stamps are sold now. He shall cause to be issued a postal telegraph card of the denomination of 15 cents, 20 cents, 25 cents, 40 cents, and 50 cents on one side, and on the other side places shall be ruled for writing of postal telegraph messages. The rate begins at 20 cents for 20 words, up to 1000 miles, all words counted. The postmaster-general is authorized and directed to advertise for three months for sealed proposals from any telegraph company or companies for the transmission of correspondence by telegraph according to the provisions of the act and shall contract with the lowest responsible bidder. If any such proposals either to sell existing lines or to construct new lines for the government are deemed fair and reasonable, the postmaster-general will report the same to Congress at its next session for acceptance or rejection. In the event of no existing or heretofore organized telegraph company being willing to contract for performance of service by this act, the Secretary of War shall be authorized to build the lines necessary.

THE TELEPHONE.

A NEW TELEPHONE CABLE.—A new kind of telephone cable capable of including twenty-five wires has been devised by Mr. Madsen, director of the Danish Telegraph Company. It can bear a span of over seventy yards, and its use is likely to reduce the danger from a multiplicity of overhead wires. It is manufactured by Messrs. Felten & Guillaume, of Mulheim-on-the-Rhine.

BELL VS. BAXTER AGAIN.—A suit was commenced March 20 in the United States Circuit Court for the Eastern District of Pennsylvania by the American Bell Telephone Company and the Bell Telephone Company of Philadelphia against the Baxter Overland Telephone Company, George W. Mears, Morris H. Allburger and others. The complaint is based on the telephone patents of Alexander Graham Bell. The defendants are charged with infringing the Bell patents. An injunction is asked for and damages are claimed.

THE ROGERS TELEPHONE.—Yesterday morning, says the Washington *Republican* of March 21, a competitive test between the Bell telephone and the Rogers telephone was made in Philadelphia. The Disston Bros., well known millionaires, requested Mr. Rogers to make this test over a seven-mile wire, between their two factories, and pronounced the Washington invention far superior to the Bell telephone. Among the gentlemen present were Dr. Beckwith, who started the "Baxter" or "overland telephone," clearing $70,000. He was greatly delighted with the competitive test, and immediately secured an interest in the new telephone.

ALL THE DRAWBAUGH EVIDENCE IN.—The People's Telephone Company, representing the Drawbaugh claims, has concluded its testimony at Harrisburg, Pa. The company has been examining witnesses for several months in that city in rebuttal of testimony given in the interest of the American Bell Telephone Company, and maintains that it has greatly strengthened its case. The next meeting will be held in Philadelphia, when the Bell Telephone Company will produce witnesses to question its claim to priority in inventions. It is probable that the long pending case will be submitted to the New York courts next summer.

TWENTY-FIVE CENTS PER MONTH RENTAL.—"Working under no less than thirty patents," says the New York *World*, "and having achieved by their system successful oral communication with places further apart than ever contemplated by the constructors of the Bell telephone, the 'Molecular Telephone Company' now proposes to establish its lines and introduce its instruments for not only public and private business, but for every-day domestic use, at incredibly cheap rates—25 cents per month being the proposed private-line rent. In this novel application the use of cork and other non-inductive materials is claimed to be the improvement that enables voices to be heard over the wire at distances exceeding 1,000 miles."

SUDDEN DEATH.—William E. Rodgers, chief operator of the Bell Telephone Company, died suddenly at noon to-day, says the St. Louis *Chronicle* of March 22. While attending his duties at the central office he was seized with a severe hemorrhage of the lungs, dying before medical aid could be invoked. His body was removed at once to his late residence. He felt unusually wells although he had been complaining of lung troubles for some time. The hemorrhage must have taken him very suddenly, for he had made no complaint. He died quietly in about five minutes. Mr. Rodgers lived with his widowed mother at No. 2021 Morgan street. He was about 27 years of age, steady in his habits and pronounced by his associates to have been one of the best telephone men in the country. He had been with the Bell Company eight years.

UNDERGROUND WIRES IN WASHINGTON.—Under the direction of Colonel Rockwell, Superintendent of Public Buildings and Grounds, Washington, D. C., the work of connecting the various department buildings and the Capitol and White House by underground telephone wires is now being rapidly pushed forward. The State, War, and Navy Building, the White House and the Capitol are now in telephonic communication under the system, and connections are being laid between all the Government buildings. Telephones will be placed in every executive officer's room, and in each committee room at the Capitol. In some of the departments heads of bureaus will also have telephones. The purpose is to so connect the underground wires that any two Cabinet officers, for example, may converse with each other by telephone as privately as though sitting at the same desk. Direct communication will also be had with the various bureaus without the services of telegraph operators.

THE ELECTRIC LIGHT.

AND YET THERE IS INGRATITUDE.—A Boston gas manufacturer asserts that the demand for gas has increased in that city since the introduction of electric lights.

THE THOMSON-HOUSTON SYSTEM.—It is said by those who should know that the new Thomson-Houston sixty-light machine, with only a single commutator, full standard lights, is the "boss" machine. There is no difficulty in believing anything good about this system.

STILLWATER, MINN.—The Stillwater, Minn., Excelsior Electric Lighting station, constructed during the past winter, is now running with great satisfaction to all concerned. Sixty arc lamps are in use, and there are good prospects of the addition of thirty more by the middle of April—or as soon as the management can secure sufficient machinery. Mr. D. H. Sullivan is superintendent.

LIGHTING BIDS.—Among the bids received by the Gas Commission of New York for lighting the public lamps one year from May 4, 1885, were the United States Company's bid for 282 lamps south of Fourteenth street, at 70 cents per night each, and that of the Brush Company for 475 lamps north of that street, 70 cents each per night. The bids will be considered at the next meeting.

CAPITOL HILL, WASHINGTON.—The Brush Electric Light Company are placing twelve large electric lights around the temple above the rotunda of the capitol, Washington, for the purpose of illuminating the grounds and the surrounding sections. Workmen are busily engaged in putting the lights in position, and within a few days they will be put in use. It would be difficult to find a more conspicuous place for the lights.

A STANDARD OIL COMPANY MOVE.—It is said that the Standard Oil Company, which has now a controlling interest in the New York Steam Company, proposes to introduce the Parker electric light system in this city, having concluded negotiations with the Parker Co., of Little Falls, through the steam company. Stockholders of the steam company have also organized the New York & Brooklyn Electric Light Company and purchased an interest in the Sawyer-Man system. By this means and by furnishing power to the National Cable Company for its cars, the waste steam will have been utilized very profitably, and the Standard Oil Company will have gained a strong hold on New York. The development of these plans will be very interesting and important.

ACTIVITY OF THE BRUSH-SWAN CO. OUT WEST.—The Brush-Swan Co. of Tucson, Arizona, furnish the city with 15 arc lights, six of which are suspen ed from a mast on the Court House, 125 feet high. The charge is $4,200 per annum. The power plant of the company consists of one 65 horse-power Westinghouse engine and one 50 horse-power Corliss, with three boilers aggregating 175 horse-power. The Brush-Swan Co. of El Paso, Texas, is running two 45-light dynamos with an 80 horse-power Westinghouse engine, and is now installing 500 Swan incandescent lights with 30 No. 2 Brush secondary batteries. The installation at Silver City is described in another item. The installation at Tucson will soon be able to give one hundred lights, it is said, and it is hoped to run a large number of Swan lamps, now in store, at a time not very remote. Mr. Titus Cronise, of Tucson, is prominently connected with these three promising enterprises of the frontier.

THE BRUSH LIGHT AT SILVER CITY, N. M.—The installation at Silver City, New Mexico, has now been running about four weeks. It comprises a No. 7 Brush dynamo, with the new style of armature, giving 45 good lights. It is worked by an engine of 50 horse-power, and the outfit includes a storage battery. The local Brush-Swan Company expect to have the lighting shortly of some of the main streets, and 3 lights are already shown on the thoroughfares by private parties. Mr. H. W. Brennan lights his stamp and concentrating mill for working silver ore with two of the lights. They give perfect satisfaction, showing all the colors of the ores and sand as well as the daylight does. Silver City is 6,000 feet above the sea, and one drawback to electric lighting there is that the nearest machine shop is 300 miles away at El Paso, Texas. The Superintendent of the station, Mr. Joseph Wills, hails from Cleveland, O., where he spent two years at the Brush Works. He may well ask: "How's this for high?"

PROGRESS OF THE EDISON SYSTEM.—Major S. B. Eaton says: I have just returned from a visit to the small country towns where our isolated system is in operation. They are thirteen in number. Two syndicates are forming to extend this work. The gas companies have cut under us, of course. But we keep our price up at the rate of $2.25 per thousand for gas and earn dividends after the first six months. Our lamp factories have already shipped this year 80,000 lamps to Europe. Companies for lighting Paris and Berlin have just been formed. What are we doing for New York? We are adding to the power at the downtown station. Our business there will average $10,000 a month. A central station will be built this summer near Madison Square for house illumination. We have also contracted to light the new Eden Musée, Park & Tilford's new store, and the Gorham silver-ware building in this city. Ninety per cent. of our stock is held by five people, who do not trade in it.

MISCELLANEOUS NOTES.

CONSOLIDATING EXCHANGES.—Members of the recently organized Miscellaneous and Electric Stock Exchange are discussing a proposition to unite with the New York Petroleum Exchange. It is desired to have the Directors of the first named organization formulate a plan for consolidation and submit it to the Oil Exchange.

THE CONVENTION OF INVENTORS.—The first National Inventors' Convention was opened in the Music Hall, Cincinnati, O., on the 25th, 2,000 delegates, representing nearly every State in the Union, being present. Conversation with several delegates shows a feeling against the bills pending in Congress concerning inventions and patents, and a discussion of this subject will take a prominent place in the proceedings of the convention.

CURING ELEPHANTIASIS.—Electricity has been called upon to assist in curing Arabs of the tumid swelling of the limbs known as elephantiasis. Electropathy, applied as soon as possible after the first manifestation, checks, and ultimately cures it. The cure is generally perfect, and takes place at the end of a few days in some cases; but if the elephantiasis is of long standing the cure is also a long process, and must be accompanied by proper medicines. The electrolysis is effected both by continuous and interrupted currents sent through the tumid swelling.

STEEL WITHOUT MAGNETIC CAPACITY.—At a recent meeting of the institution of Mechanical Engineers, London, specimens were shown of steel castings and pieces of steel wholly without magnetic capacity, including axes and other tools carrying a fine cutting edge, which were the objects of very great interest to those present, for these cast tools require no treatment of any kind when they come from the mold. The steel of these remarkable properties is made by thoroughly incorporating from 7 to 12 per cent. of rich ferro-manganese, containing about 80 per cent. of manganese. The applications of this remarkable metal are innumerable. Tools of almost every description can now go straight from foundry to grinding and finishing rooms, while for the numerous engineering purposes to which steel is applied, strength, toughness, and hardness are now added by the process.

BATTERY NOTES.—Herr C. Schneider, of Dresden, has invented a dry galvanic battery. It consists of two cylinders, the larger one of copper and the inner or smaller one of amalgamated zinc. Both cylinders are open at each end, and the space between them is filled with a mixture of plaster of Paris and a saturated solution of chloride of zinc containing 7 per cent. of chloride of sodium. Sir W. Thomson maintains that the Lalande-Chaperon cell is inferior to the Bennett in electromotive force, but is superior to every other form with which he is acquainted in its remarkable capacity for giving strong and steady currents from plates of moderate area. With a Skrivanow battery, weighing 100 grammes, M. D. Monnier recently obtained an electromotive force of 1 45 to 1.50 volt, and a current of 1 ampère for 1 hour.

THE BEST WIRE FOR ELECTRO-MAGNETS.—The recent researches of Prof. Hughes go to support the theory that for making the wires of electro-magnets Swedish iron is the best that can be used. In the case of tempering—that is, increasing molecular rigidity and the power of retaining magnetism—the following figures are given as useful: Crucible fine cast-steel, cooled completely in cold water, had a magnetic capacity of 28; bright yellow, let down in water to white, 58; red heat, cooled completely in water, 66; red heat, cooled in oil, 72, and annealed, 84.

STOCK QUOTATIONS.

Telegraph, telephone and electric light stocks were quoted as follows on Thursday at the Electric, Manufacturing and Miscellaneous Stock Exchange, and at the Stock Exchange:

TELEGRAPH.—Am. Cable, b 59¾; American Rapid, b 50, a 65; B. & M. Co., b 125¾; Commercial Telegram Company, a 80; Harlem District Telegraph Co., a 5.50; Manhattan Telegraph, b 10, a 85; Mexican, b 125, a 147; Mut. Union, b 15, a 16½; Northern & Southern Tel. Co., 1st mtge bonds, b 79, a 81; Postal Telegeaph (stock), b 7.50, a 8; Postal Telegraph bonds, 1st 6 per cent., b 57.78, a 58; Postal Telegraph and Cable Co., b 16, a 16.62; Western Union, b 72¼, a 72⅝.

The Bankers and Merchants' Telegraph Company has voted to increase its capital, $1,000,000 to $3,000,000, and offers stockholders of April 18 new stock at par in the proportion of one new share for two old, the stock to be delivered April 21, when this option expires. The stock sells at 124@125.

TELEPHONE.—American Bell, b 171; American Speaking, b 110, a 125; Currier Telephone Bell, b 3; Colombia and Panama, b 24.50, a 25; Continental, b 15; Dolbear, b 5, a 10; Erie, b 28, a 35; Globe, b 9.50, a 12; Hudson River, b 60, a 90; Inter-Continental, b 75; Mexican, b 2.40, a 2.75; Mexican Central, a 3; Molecular, b 5, a 10; Metropolitan, b 31, a 32; New York, a 85; New York and New Jersey, a 80; New York and Pennsylvania, b 50, a 78; Overland, b 8, a 17; People's, b 9.75, a 18; People's (N. E.), b 1.50; Shaw, b 10; Solenoid, a 125; Southern Bell, b 95, a 125; Southern New England, a 175; West India Telegraph and Telephone, b 1.75, a 2.

Our Chicago correspondent sends the following Telephone quotations as of the 25th inst.: Central Union, b 48, a 60; Michigan, b 100, a 105; Missouri & Kansas, b 73, a 76; Iowa Union, b 75, a 80; Wisconsin, b 105, a 115; Chicago, b 285, a 300; Interstate, a 50.

The Boston *Advertiser* of March 25 says: Although the question of issuing 6 per cent. bonds to the amount of $300,000 or $400,000, to provide for the floating indebtedness and other wants of the New England Telephone Company has been informally considered, it is now said that a majority of the directors believe in the passing of the dividend until such time as the earnings shall admit of its payment after all construction work is all provided for.

The Boston *Advertiser* of the 27th thus quotes the local market: In telephone stocks Bell declined 3 to 168; New England advanced ¼ to 31; Erie ⅛ to 33⅛; Mexican ⅛ to 2⅛, and Tropical closed at 2¼ as before.

The Mexican telephone annual meeting is called at 120 Broadway, New York, April 9. The books close March 29 and reopen April 9. It is said that the company will make a good report, showing a great change since a year ago.

It is reported that there is a prospect that the New England telephone property will be bonded for say $200,000 to $300,000 and interest payments continued. A meeting upon the subject will be held.

Mr. Marx, of the Drawbaugh telephone syndicate, says that they have now $368,000 in cash and bills receivable, and $6,000,000 worth of stock of sub-companies in the treasury. They will get $10,000,000 more if a decision is given favorable to them, while the original stock of the syndicate is only $5,000,000. They say they have spent $250,000 in litigation.

The Boston *Herald*, of March 26, says: Bell telephone sold up to 172½, off to 171, and up to 172½ again. The annual meeting passed without unusual incident, other than a motion for an investigating committee, which was quietly tabled. The meeting was more numerously attended than any of its predecessors, a fact attesting the growth of stockholders. The financial exhibit showed continued prosperity, net earnings equalling 15.3 per cent. on the capital stock, against 13.2 per cent. the previous year. Assets and liabilities nearly doubled, being $11,952,152.31 in 1882-83, and $21,491,016.37 in 1883-84. A singular fact is that "patents" figure as assets the former year and as liabilities in 1883-4, "a matter of book-keeping" probably. Book-keeping is a remarkably elastic science.

ELECTRIC LIGHT STOCKS—American, b 2, a 4; Brush, b 58, a 80; Brush Illuminating, b 45, a 70; Daft, a 65; Edison, a 145; Edison Illuminating, b 55, a 75; Edison Isolated, b 55, a 90; Edison European, b 3, a 15; Excelsior, b 20; Swan Incandescent, a 40; United States, b 90, a 96; United States Illuminating Company, a 95.

BUSINESS NOTICES.

BRAIDING MACHINERY FOR ELECTRIC WIRE.—The Rhode Island Braiding Machine Co., of 89 Alborn street, Providence, R. I., are manufacturers of braiding machines specially adapted to the insulating of telegraph, telephone and electric light wires. Their machines are of various sizes and capacity, and are used by the chief makers of insulated wire in this country.

THE FISKE-MOTT HIGH-RESISTANCE INSULATOR.—This insulator, made by the Chicago Insulating Co., and described as well as illustrated by us last December, is becoming very popular, owing to the immense reduction made in it of the contact surface. One of the latest specimens now lying before us is beautifully finished and has every appearance of durability.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

Edited by N. S. KEITH, Electrical Engineer and Expert, 237 Broadway, New York.

PATENTS DATED MARCH 11, 1884.

Branching Electric Cables; Richard S. Waring, of Pittsburgh, Pa.; reissue..... 10,459
Branch connections are made by cutting through one or more of the ribs transversely and longitudinally a suitable distance, opening the parts outward, then severing the insulated conductor, bending the ends so formed outward and closing the divided parts of the armoring thus opened, and soldering the same.

Compound Electric Cable; Richard S. Waring, of Pittsburgh, Penn..... 295,086
Consists in so twisting and laying the strands of an electric cable that the inner strands come to the surface in regular succession and at desired intervals for the purpose of ready access for making branch connections or loops.

Dynamo-Electric Machine; Charles Richter, of Camden, N. J..... 294,913
A machine of the Gramme type, with some provisions for ventilation of armature; and the field magnets arranged with their bases on the inner surface of a ring.

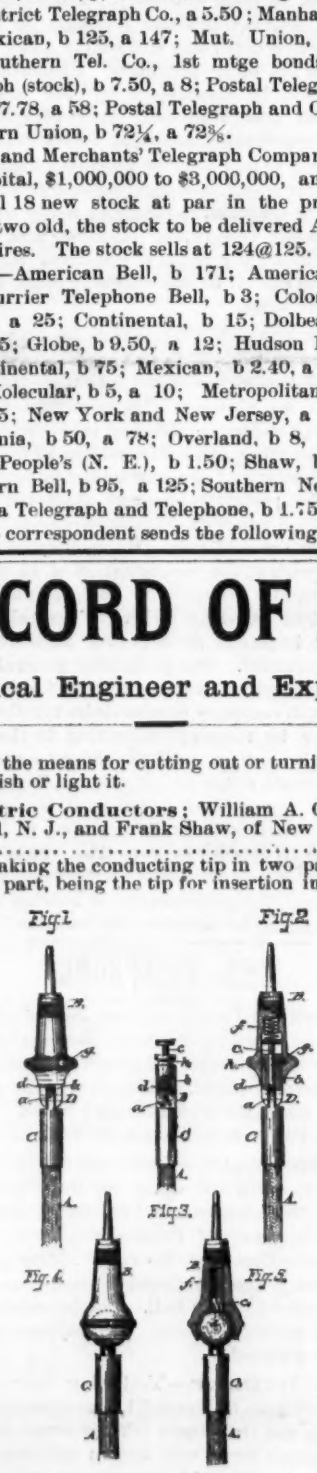
Dynamo-Electric Machine; Charles M. Lungren, of New York, N. Y..... 294,892
Two circuits are provided. One is always closed, and constitutes the magnetizing-coils of the field. The other is a shunt-circuit from the multiple-arc circuit, in which lights or other working devices are placed. The invention is applied to one machine with double commutators, or to two or more machines arranged so as to constitute one generator.

Electric Wire Connector; Thomas S. Stevenson, of St. Louis, Mo..... 294,928
A convenient mode of connecting and disconnecting wire electric conductors. It is useful on a railway train; and if a car should break loose the circuit is closed automatically on both train and car.

Electric Light Regulator and Cut Out; Robert J. Sheehy, of New York, N. Y..... 295,058
Consists in method of and apparatus for automatically maintaining the proper relative positions of the carbons, and for automatically withdrawing a defective lamp from the circuit, and for automatically reintroducing the lamp into the circuit when the conditions necessary for successful operation are restored. It is operated by spring clock-work mechanism, controlled by electro-magnetism.

Electric Lamp; Alexander Welsh, of St. Denis, Md., Assignor to the Viaduct Manufacturing Co., of Baltimore City..... 295,088
The invention is in the nature of a base for an electric lamp and containing the means for cutting out or turning off the current to extinguish or light it.

Tip for Electric Conductors; William A. Childs, of Englewood, N. J., and Frank Shaw, of New York, N. Y..... 294,851
Consists in making the conducting tip in two parts, jointed to each other; one part, being the tip for insertion in a binding-post



or socket, is connected with the other, which is fastened to the flexible conductor by a ball-and-socket joint, or its equivalent, so that the tip may be moved, turned or twisted without twisting the flexible cord or conductor. The illustrations do not need specific description.

Holder for the Carbons of Incandescing Electric Lamps; Alexander Welsh, of St. Denis, Md., Assignor to the Viaduct Manufacturing Co., of Baltimore City..... 295,087
Consists of a piece of wire having its end flattened, the flat portion pierced with a hole corresponding to the shape of the filament, bent over the line of said hole and pressed on a form of the shape in section of the filament, thus forming a tube to receive the carbon filament.

Retouching Machine; Charles H. Shaffer, of Rockford, Ill., Assignor of one-half to Jones, Woodruff & Co., of same place..... 294,817
This invention relates to that class of machines which are capable of use mainly in the fine arts for the purpose of retouching crayonings, negatives, and other work requiring retouching to produce the desired effects. The pencil is capable of either a rotary or a reciprocating movement, or both conjointly, by means of a small electric motor on the top of the pencil.

System of Electric Haulage; William E. Ayrton and John Perry, of London, England..... 295,094
Electric motor for traveling on a cable and pulling a load behind it. Grips, etc., are provided to prevent slipping under heavy loads.

Telegraph Wire Supporter; Ross C. Stone, of New York, N. Y..... 295,073
Bisected discs or washers of insulating material are bound on the supporting and conducting wires by means of binding wire passed circumferentially around the discs; and the binding wire acts as the supporting connection between the two lines of discs.

Telegraphic Transmitter; Ross C. Stone, of New York, N. Y..... 295,074
A person operating keys like those of a type-writer can with this instrument send a telegraphic message as correctly as an expert operator can with the ordinary key or other instrument.

Telegraphic Transmitter; Ross C. Stone, of New York, N. Y..... 295,075
A detail of apparatus for converting an alphabet into a corresponding telegraphic alphabet.

Underground Electric-Conductor System; Thomas J. Perrin, of New York, N. Y., Assignor to Charles P. Huntington, of same place..... 294,906
This is built up of short lengths of glass tubes containing wires. The ends of the tubes are abutted against rubber washers or discs. The whole is incased in another tube, say of paper, and then in an outer pipe of iron.

Uniting Electric Cables; Richard S. Waring, of Pittsburgh, Pa.; reissue..... 10,458
Consists in the method of uniting the sections of the cable and connecting the wires.